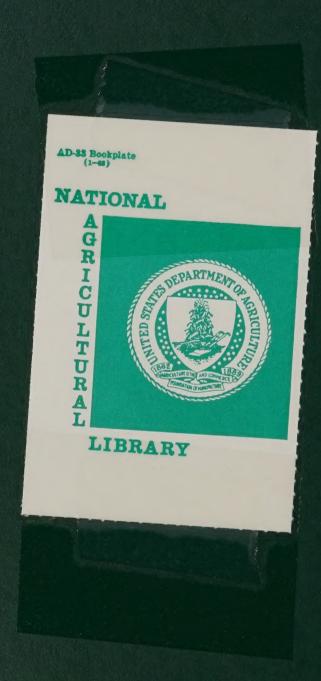
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POTENTIAL EXPOSURE OF DIFLUBENZURON (DIMILIN®) TO BIRDS, NON-TARGET AQUATIC ORGANISMS, AND HUMANS

(A Cooperative USDA/STATE/USEPA Assessment)

September 22, 1978

U.S. DEPARTMENT OF AGRICULTURE
LAND-GRANT UNIVERSITIES
U.S. ENVIRONMENTAL PROTECTION AGENCY

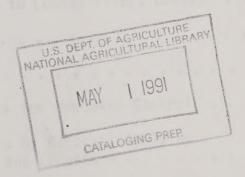


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SUMMARY

An assessment was made of the possible levels of exposure to diflubenzuron (Dimilin) that might be experienced by birds, non-target aquatic organisms, and humans as a result of the anticipated uses of this insecticide on cotton, soybeans, hardwood and coniferous forests, and in mosquito control. The evaluation was conducted by U.S. Department of Agriculture, Land-Grant University Scientists, and U.S. Environmental Protection Agency, and was drawn from data available in USEPA files and published information.

Avian Exposure. Direct application of diflubenzuron to crops, forests, and water will result in low-level exposure of certain avian species to diflubenzuron residues, primarily through the diet. However, comparison of the maximum anticipated exposure levels to the demonstrated lowest effect levels of diflubenzuron on birds indicates that in no case will anticipated uses of diflubenzuron result in any discernible effects on birds, either acute or chronic. This is due both to low application rates of diflubenzuron in all proposed uses and to its demonstrated low acute and chronic toxicity to birds. Diflubenzuron will not accumulate to any appreciable degree in waters capable of supporting fish, it is not highly bioaccumulated by fish, and thus its use should result in only very minimal exposure to fish-eating birds

Exposure to Non-Target Aquatic Organisms. A variety of non-target aquatic organisms may be exposed to residues of diflubenzuron as a result of its use on water, crops, and forests. Studies have shown that diflubenzuron is not highly toxic to fish and other aquatic vertebrates. Based on available data, it appears likely that direct application of diflubenzuron to water for mosquito control will cause

should minimize run-off from these environments because diflubenzuron adsorbs strongly onto organic matter. The potential for significant diflubenzuron movement away from application sites through run-off is further reduced by the fact that the compound generally has a short persistence in soils (half-life <7 days).

There are no experimental data available on the long-distance transport of diflubenzuron or any other pesticide down river drainage basins after run-off events. However, research personnel at the USEPA Water Quality Laboratory, Athens, GA, have utlized a mathematical model in an attempt to obtain some estimation of the compound's potential for entrance into and movement down major drainage basins. Projections were made of diflubenzuron residue levels entering streams at the point of field discharge, and these were coupled with projections of dilution, transport, and degradation in the mainstream flow to give projections of diflubenzuron concentrations at the mouths of selected river systems in the southern United States. The drainage basins of the rivers considered comprise much of the cotton and soybean production areas that will be subject to diflubenzuron treatment.

run-off of diflubenzuron from treated fields was available for the development of the USEPA model. Further, many assumptions had to be made in the development of the model that allowed data output to be kept at manageable levels, yet some of these are not representative of either the likely diflubenzuron use patterns or of the environmental parameters likely to occcur. Assumptions in the model that are of particular significance include:

1) That weather patterns over all of the drainage basins are identical with

respect to time and intensity and thus that run-off will take place in all fields in all basins at the same time. In reality, except for rare major storms

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of hurricane proportions, summer rainfall in the cotton and soybean belts is almost always associated with localized thunderstorms, thus areas subjected to run-off at any one time will be a small fraction of the whole.

- 2) That crops will be treated with diflubenzuron at uniform rates on a beltwide, uniform schedule. Actually, the distribution in time of diflubenzuron applications throughout the cropping areas will be a continuum over the entire application season, with the frequency of application varying considerably, thus the likelihood of large scale run-off of freshly applied material from the cropped areas is greatly reduced.
- 3) That all of the cotton and/or soybean acreage within the drainage basins will be treated with diflubenzuron. This is not likely to occur, because projected use patterns of diflubenzuron indicate that on cotton and soybeans, actual acreages treated with diflubenzuron will probably not exceed about 15% and 5%, respectively, of the acreages planted to these crops.
- 4) That all run-off from treated areas will be discharged directly to flowing streams for immediate and continuous transport by rivers. However, major reductions in diflubenzuron concentrations through adsorption to soils, settling, and chemical breakdown, would take place as delays in movement over swales, ditches, or drainage systems occur.

Without compensation for the errors introduced by the assumptions listed above, the model projects that diflubenzuron residues discharged at the mouths of certain rivers would periodically reach the low part per billion range, although projected residues were generally sub part per billion. If the concentrations projected by the model did indeed occur periodically in water

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discharged by these river systems, adverse effects on populations of certain non-target aquatic organisms might occur. Based upon available laboratory toxicity data, the species potentially affected would include mysid-, grass-, and brine shrimp, and blue- and marsh crab.

Modeling projections of the levels of diflubenzuron or any other pesticide that might be discharged by major river systems would appear to be, at best, of limited value if the projections are not based on validated scientific parameters. In the case of diflubenzuron, there are no data indicating that the proposed uses of diflubenzuron will result in any residues being discharged into estuarine or salt water environments, thus the possibility that diflubenzuron may interact with any organisms in such environments still needs resolution.

Human Exposure: Dietary. Estimates were made of maximum or "worst case" dietary human exposure to diflubenzuron if the compound is used as an insecticide on cotton, soybeans, forests, and for mosquito control. The mosquito and forest applications of diflubenzuron will not likely lead to any significant residues entering the human food chain. Cotton and soybean uses may, however, result in exposure to diflubenzuron and/or its metabolites through direct human consumption of cotton or soybean seed and their processed fractions, and consumption of meat, milk, and eggs from livestock and poultry fed cottonseed and/or soybean seed fractions from diflubenzuron-treated crops. Fish may also be a source of dietary exposure to diflubenzuron, if run-off or drift from treated crops occasionally results in appreciable water residues that persist for several days.

"Worst Case" projections for all potential dietary sources of diflubenzuron indicate that even under the most adverse circumstances, diflubenzuron residues entering the human food chain will be extremely low. Based on available food

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til be extremely low. Based on aveilable food

consumption tables and the "worst case" levels of diflubenzuron that might appear in various foodstuffs, total diflubenzuron exposure to the average human will not exceed 0.00002840 mg diflubenzuron/kg body weight/day. Maximum dietary exposure to diflubenzuron residues of infants consuming formula containing soybean fractions would be on the order of 0.00024 mg/kg/day assuming that all of the soybean fractions in the formula contained 0.05 ppm diflubenzuron, the minimum sensitivity level of the analytical enforcement level. Taking into account that diflubenzuron will be used only on a relatively small proportion of the total cotton and soybean acreages (~15% and ~5% for cotton and soybeans, respectively) and that residues in seed of treated crops will in essentially all cases be below 0.05 ppm, it seems likely that average human dietary exposure to diflubenzuron will be much less, perhaps 1/10-1/100, of the "worst case" estimates obtained.

Human Exposure: Applicators, Field Workers, Bystanders. Projections were made of the potential exposure of diflubenzuron to applicators, field workers, and bystanders as a result of its use on cotton, soybeans, forests, and as a mosquito larvicide. These estimates suggest that persons involved directly in the application process (mixer/loaders, ground spray equipment operators, etc.) will be subject to considerably higher levels of diflubenzuron exposure than will either field workers or bystanders and residents present in or near the treated areas. Most of the potential exposure to applicators and associated personnel will be dermal rather than respiratory, and persons involved in the formulating (in the case of granular for mosquito control), mixing, and loading operations may be subject to potential diflubenzuron exposure at levels comparable to or higher than those of the applicators themselves. The number of bystanders potentially exposed to diflubenzuron will be greater as a result of its use on cotton and soybeans than for other applications, primarily because of

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or higher the and the applicators themselves. The member of the or higher of the applications the greater as a result of the applications, printerly because of

the much larger acreages involved, higher number of repeat applications, and the number of residents within closer proximity to the treated fields. Current cultural practices for potentially treated sites are such that field workers (equipment operators, scouts, etc.) are not expected to receive substantial dermal or respiratory exposure as a result of the diflubenzuron applications. The estimates of potential human exposure to diflubenzuron generated here should be useful in any subsequent analysis of the possible risks associated with this insecticide.

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ACKNOWLEDGMENT

This assessment of the potential exposure of diflubenzuron to birds, non-target aquatic organisms, and humans was conducted by USDA, Land-Grant University scientists, and EPA. The responsibility for the contents rests with those individuals. However, scientists of the Water Quality Laboratory, Athens, GA, provided invaluable input into a portion of this assessment through discussions of their model of diflubenzuron movement through major river systems of the southern United States. These scientists included J. W. Falco, K. F. Hedden, and L. A. Mulkey. Useful discussions and analysis of the water transport model were also provided by R. A. Leonard, Southern Piedmont Conservation Research Laboratory, SEA, USDA, Watkinsville, GA.

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INTRODUCTION

In January 1978 the U.S. Department of Agriculture and the U.S.

Environmental Protection Agency established a joint team to conduct a benefits/
exposure assessment of the chitin synthesis inhibitor insecticide, diflubenzuron
(Dimilin®). The document herein was generated by USDA, Land-Grant University
Scientists and EPA to evaluate, to the extent possible, the degree of exposure
to diflubenzuron that might be experienced by birds, non-target aquatic
organisms, and humans (both through the human diet and by direct exposure to
applicators, field workers, and bystanders) as a result of diflubenzuron use.
This report arose primarily as the result of three meetings, at Crystal City,
VA, April 25-26, 1978; Athens, GA, June 6-7, 1978; and Beltsville, MD, July 25,
1978. It is being provided to EPA and to the Joint USDA-STATE-EPA
Benefits/Exposure Study Team on Diflubenzuron with the hope that it will be of
value in the regulatory decision-making process concerning diflubenzuron.

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PROJECTED EXTENT OF USE

The potential exposure associated with diflubenzuron will be directly related to the extent of use, and since diflubenzuron is currently registered only for control of the gypsy moth on hardwood forests, actual use experience is limited. Therefore, projections of potential use related to pending and projected registrations were made. Resource persons were assembled to develop estimates on possible diflubenzuron use in view of their knowledge of insect problems, of current control practices, and of research results with diflubenzuron. Estimates were made of quantities of diflubenzuron that might be used for control of (1) the boll weevil on cotton, (2) the velvetbean caterpillar, green cloverworm, and Mexican bean beetle on soybeans, (3) the gypsy moth on hardwood trees, (4) the Douglas fir tussock moth in western coniferous forests, and (5) mosquitoes breeding in intermittent fresh water.

The estimates generated (Table 1) are optimistic projections of uses that might be anticipated. These estimates are essentially the same as those that are being used in the benefits studies being conducted by the Joint USDA/State/EPA Study Team and are compatible with the pending labels for use on cotton and the originally proposed label for soybeans (Table 2). The estimates for gypsy moth will not be valid unless the current gypsy moth label or the current interpretation of the label by the USEPA is modified. However, the estimates were made in relation to the desired use envisioned by the USDA and its cooperators. Similarly, there is not a pending label for use of diflubenzuron against the Douglas fir tussock moth, but estimates are included because of the potential importance of this use. Also, estimates for the

Table 1. Projected extent of use for selected uses of diflubenzuron.

Pest		t likely rate AI/Acre)	No. of appl.	Acres .to be treated (in 1000's)	acre	s Lb
Boll weevil	Cotton	0.0625	6.0	1,540 ^a	9,240	577,500
Velvetbean caterpiller	Soybeans	0.0312	1.	11,250 ^b	1,375	42,900
Green clover- worm			•			
Mexican bean beetle						
Gypsy moth	Hardwood trees	0.0312	1.3	500 ^c	650	20,300
Douglas-fir tussock moth	Conifer trees	0.125	1.0	44 ^d	44	5,500
Mosquitoes	Inter-	0.025	1.0	400 ^e	400	10,000
m	ittent water				11,755	656,200

equal to about 50% displacement of current boll weevil insecticide on acreage requiring treatment. ^b Based on 50% replacement of insecticides now used for these insects. Acreage used in benefits analysis may vary slightly from this number. ^c Estimates of needs for control, containment, and eradication in government programs. These estimates are based on needs for 1979, 1980, and 1981. ^d Outbreaks occur about once every 9 years, if 400,000 acres were treated as a result of each outbreak, the annual average would be about 44,000 acres. ^e Expert estimate based on the potential replacement of up to 400,000 acres of 1,412,000 acres of intermittent water treated for larval control.

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Table 2. Summary of proposed uses and maximum application rates for diflubenzuron.

		ite
Use	Lb/AI/acre/application	Maximum total lbs AI/season
Cotton	0.0625 - 0.125	0.75
Soybeans	0.0312 - 0.0625	0.125
Hardwood Forests (gypsy moth)	0.0312 - 0.0625	0.0625
Coniferous Forests (tussock moth)	0.125	0.125
Mosquito control	0.025 - 0.04	0.08

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around the most critical needs for mosquito control with the assumption that label modifications might be made in the future to permit diflubenzuron use against mosquitoes on such important sites as flooded or irrigated pastures.

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s are not compatible with the pending lebel, but were developed to more devicted needs for manguing control with the assumption that if attons might a made is the future to permit dilluperation in cosquitors to such important sites as flooded on irrinated pastures.

AVIAN EXPOSURE

USE PATTERNS AND APPLICATION RATES

This avian exposure assessment, for the uses of diflubenzuron on cotton, soybeans, intermittent fresh water, and forests, was based upon current or proposed labels as summarrized in Table-2. Proposed application rates to cotton season. Proposed application rates to soybeans are 0.0525-0.0625 lb Al/acre, with a maximum of two application rates are from 0.0312-0.0625 lb Al/acre with a maximum of one application per season. In coniferous forests for control of the Douglas-fir tussock moth, the application rate will be 0.125 lb Al/acre with a maximum of one application per season. The proposed application rate to intermittent fresh water for mosquito larvae control is 0.025-0.04 lb Al/acre intermittent fresh water for mosquito larvae control is 0.025-0.04 lb Al/acre difluermittent fresh water for mosquito larvae control is 0.025-0.04 lb Al/acre with a maximum of two applications per year. The projected extent of use of difluernorm for each of these proposed applications (Table 1) has been

ESTIMATED AVIAN EXPOSURE LEVELS

discussed in the previous section.

Dietary Weed Seed and Grit Exposure. Application rates at 0.0625 and 0.125 Ib Al/acre, for soybeans and cotton, respectively, would result in maximum expected residues immediately following application, of 7.2 and 14.4 ppm to exposed seeds. Exposed grit, on these same treated areas, would have a comparable surface/volume ratio and, as such, would be expected to have similar residue levels as seeds. A wide variety of granivorous bird species inhabiting forest and agricultural ecosystems would be exposed to these residue levels.

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Engage is, intermittenic fresh water, and prests, as
treposed lines as sufer, and in Table-2. Propist applies
etc. 0.1825-0.125 lb Affacts, with a malmum of 0.75 lb Af pe
season. Proposed application rates to soyboom are 0.0312-0.062
with a maximum of two applications per growing season. For con
each in actioned forests, application rates are from 0.0312 0.00cc
with a stained of ore application per reason. In conferous a
we the finalestin bestrok moth, the application rate will be 0.12
with a maximum of one application per season. The proposed by the
theoretical fresh where for mesquite larvae control is 0.025-0.0
with a functional of the applications ner years. The projected exten

discusses in the previous sections

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Dietary Mori Sord and our Lapasare. Application, would feelic the expected residues careciately following application, of 7.2 and an associate residues careciately following application, of 7.2 and an associated residue. Exposed gritt, on these sale areas, would be expected to comparately surface/volume ratio and, as such, while be expected to residue fevels as meds. A wide variety of grantvorous bird specificate and expected to those residue.

Food Utilization: Soybeans. A number of waterfowl, song bird, and upland game bird species are known to utilize soybeans in their diets (Gusey and Maturgol, 1973). At the time of treatment, the soybean seed is within the unopened pod thus unexposed to the field application. The whole pod is expected to have a maximum residue level of 0.75 ppm assuming a maximum treatment rate of 0.0625 lb AI/acre. It is expected therefore that the seed itself will have even lower residue levels.

Douglas-Fir. It is anticipated that diflubenzuron will be applied at 0.125

1b AI/acre to suppress Douglas-fir tussock moth populations. As a consequence

of that application maximum residues of 2.2 ppm were found to occur on

Douglas-fir buds or newly emerging shoots (Shea, 1977). These buds or newly

emerging shoots can be an important spring food source for forest dwelling

grouse.

Fish. The highest rates in water would be most likely found immediately following direct application to water. The minimum water depth expected to contain a viable fish population is assumed to be about 6 inches. The maximum direct water treatment rate called for by the label is 0.04 lb AI/acre, which would produce a maximum expected residue in the water immediately following application of 14.7 ppb. The maximum reported uptake ratio from water to fish meat (Booth et al., 1976) is 134x found for bluegills. This factor, multiplied by the maximum water residue, is 1.97 ppm. Thus, the maximum potential dietary exposure of piscivorous birds feeding exclusively upon such fish would be on the order of 2 ppm.

METHODOLOGY

The calculated maximum expected residues in water or on vegetation were

efters Southerns. A mether of Paterford, North Bird, and Mylana coits are Lucius to Hilling so, hours in their dista (Guany a

197). At the time of trastment, the soybean seed is within the dest this unexposed to the field application. The whole My is expected in maximum treatment of 0.75 ppm assumers a maximum treatment of 15 histories it is expected the theorem that the seed itself will abe over

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sty ! The highest rates in water would by work likely tourd seredicially found threat application is water. 'The minimum water dopth e.g. ...d I visible fish population is assumed to be about 6 inches. The morimum treatment rate called for by the label is 0.04 lb Al/Aure which a maximum expected residue in the water immudiately following to 14.7 ppb. The maximum reported uptake ratio from water is first al., 1976) is 134x found for bluegills. This factor, polliphical water residue, is 1.97 ppm. Thus, the maximum picyontial distant water residue, is 1.97 ppm. Thus, the maximum picyontial distant factiverous birds feeding exclusively upon such fish likely has sain the

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derived mathematically from information contained in a USEPA criteria paper (Tucker, 1975). In turn, the basic data for this paper were largely adapted from Kenaga (1973). These papers, using surface-volume (weight) ratios, give calculations of deposited residues upon media of varying sizes and shapes assuming perfectly even spray deposition. They do not account for residue losses such as would be caused by drift, chemical breakdown, or other factors. Experimental data are given to show that these maximum expected residues can be obtained under ideal deposition conditions. These residue levels could only be exceeded by improper application techniques. The value given in these papers is 58 ppm/pound/acre for grain-sized seeds such as wheat. The value given for legume pods is 12 ppm/pound/acre. The base value given for water residue is .367.5 ppb/pound/acre on water exactly one foot deep. This value would occur if both perfect spray deposition and perfect mixing in the water occurred. This value does not take into account losses due to drift, adsorption, or chemical breakdown.

COMPARISON OF MAXIMUM EXPOSURE LEVELS TO LOWEST EFFECT LEVELS

Since the maximum calculable exposure levels appear to be well below the minimum effect levels shown for avian test species in all available valid long-term tests, no attempt will be made to quantitatively account for environmental factors that would tend to reduce both initial residue deposits and further diminish residues over time.

The theoretical maximum avian exposure for a single application from this analysis is 14.4 ppm by way of the diet. This figure is well below the lowest chronic effect level (40 ppm or greater) found in any valid avian toxicology study reviewed. Therefore, it seems reasonable to conclude that under the use patterns being proposed, diflubenzuron poses little acute or chronic danger to domestic or wild avian species.

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N C "EXILIVE EXPOSURE LEVELS TO LOWEST EFFECT LEVELS

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MULTIPLE APPLICATIONS

There is no well-accepted mathematical model available for estimation of residues resulting from multiple applications of a pesticide to plant matter that may serve as feed for birds. However, the following method is proposed, in the absence of chemical-measured residues under field conditions. Initial residues are estimated by the methodolegy given in a USEPA Criteria paper (Tucker, 1975).

For a treatment rate of 0.125 lb AI/acre, the maximum expected initial surface residues for various dietary components of herbivorous birds are:

	PPM PPM
·seeds	7 (1*)
forage	7
leaves & leafy crops	16
long grass	14
short grass	30
	1
debris (grit, dirt, etc.)	i
animal matter	1

At the time of the development of the USEPA Critera paper (Tucker, 1975), the label for cotton use allowed up to 12 applications at 0.125 lb AI/acre/application at 5-day intervals. Thus, the calculations reported below are based on this prior label that allowed twice as much total diflubenzuron/acre on cotton as does the current label.

^{*1} ppm is used for this calculation on the assumption that about 85% of the residue on seeds would not be eaten if the bird rejected the seed hull when feeding.

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resulting from multiple anglications of a posticing to plant serve as feed for However, the following method is propositive and chemical measured residue, under field conditions. Initiations test bed by the methodology given in a USEPA Criteria pages 1975).

treatment rate of 0.125 lb At/yers, the maximum errors of story various dietery components of herbivorous ... 33

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intervals. Thus, the calculations reported being in account that allowed twice as much total diffusions upon from the or

this calculation on the assumption that aroug fift of

Although vegetational half-life data are not available, both laboratory and field studies suggest that diflubenzuron will persist and accumulate on foliar surfaces (Verloop and Ferrel, 1977; Nimmo and deWilde, 1974). Although these data indicate that the half-life of diflubenzuron is greater than 2 months, it was assumed that plant growth would cause at least a two fold dilution of even the most persistent residues. Thus, a residue half-life of 60 days is a worst case situation.

A bobwhite quail's diet consists of approximately 87.5 percent vegetative matter, 10 percent animal matter and 2.5 percent debris (Stoddard, 1936; Tripanzee, 1948; Rosene, 1969). Of the vegetative matter eaten, nearly 76 percent and 4 percent consists of seeds and forage, respectively (Rosene, 1969). The additional 7.5 percent is comprised of long grass, short grass, leaves and leafy crops. Obviously, the exact breakdown of these secondary food sources varies considerably. As such, in order to simplify the calculations it was assumed that each of these food sources are consumed in equal amounts. Using these assumptions the following dietary profile for bobwhite quail was used to calculate exposure levels:

Seeds = 76 percent
Forage = 4 percent
Leaves and leafy crops = 2.5 percent
Long grass = 2.5 percent
Short grass - 2.5 percent
Debris = 2.5 percent
Animal matter = 10.0 percent

The formula used for residue contribution (in ppm) for any time of concern for each feed item resulting from each treatment is:

R.C. =
$$R_0$$
 (0.5) $\frac{a}{h}$

year forms half-life data are not swallands, but halfering and exactes suggest that diffuserance will person and set mulais on fed es (verloop and Ferrel, 1977; Nigro and debilde 1974). Although una ndicate that the half-life of diffuberance is guester that that plant growth would cause of Jeans.

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Long grass a 2. percent
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Anfinal matter = 10.0 percent

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where, R.C. = residue contribution

R_p = initial time 0 residue deposit
h = residue half-life

a = age of residue (days) at time of concern

Table 3 gives the computed residue contribution by feed type for each dietary component on day 55, the day of the last diflubenzuron application. Once the residue profile has been constructed, the next step is to determine what proportion of a bird's daily diet is made up of each vegetational type. By multiplying the proportion of the bird's diet by the residue expected to occur on the vegetational type (see Table 3), the dietary intake of toxicant associated with each vegetational type can be determined. By summing the intakes associated with each vegetational type, estimates of the total daily dietary intake can be made.

Seeds = .76(8.91) = 6.77

Forage = .04(62.37) = 2.49

Leaves and Leafy crops = .025 (142.56) = 3.56

Long grass = .025 (124.74) = 3.11

Short grass = .025(267.30) = 6.68

Debris = .025(8.91) = 0.22

Animal matter = .10 (8.91) = 0.89

Total PPM in diet (sum of above): 23.72

As in the previously described scenario following a maximum single application, residue levels from multiple applications appear to be below the minimum effect level such that no chronic reproductive effects are expected. The fact that current label restrictions reduce the maximum amount of diflubenzuron applied to cotton by 50% over that assumed in the above calculations is an even more definitive indication that such use will have no discernible effects on avian species.

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restricted resides contribution by their type for each protect of day 55, the day of the last diffurenzer or application one obe or ile has been constructed, the next step is to determine what is of a bing's delly diet is mine up of each respectational, hips. By the proportion of the bird's diet by the residue expected to economy of the proportion of the bird's diet by the residue expected to economy ages found type (see table 3), the dietary intake of territain and the sech regelectional type can be determined. By there is the second dietary with each regelectional type, estimates of the second deltar.

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reviously described scenario following a may level single and for, application, els from multiple applications appear to be below the adminus effect that no chronis reproductive of ects are expected. The fact that that no chronis reduce the maximum amount of dif ubenzuron applied to an even more

Table 3. Projected Diflubenzuron Residues by Vegetational Type after 12 Applications of Diflubenzuron (0.125 lb AI/acre/application) at 5-day Intervals.

No. of Applications (5-day intervals)	ماحا	SEED	FORAGE	LEAVES AND LEAFY CROPS	LONG	SHORT
	25/60	0.53	3.71	8.48	7.42	15.90
2	20/60	0.56	3.92	8.96	7.84	16.80
œ	45/60	09.0	4.20	09.6	8.40	18.00
4	40/60	0.63	4.41	10.08	8.82	18.90
2	35/60	19.0	4.69	10.72	9.38	20.10
9	30/60	0.71	4.97	11.36	9.94	21.30
7	25/60	0.75	5.25	12.00	10.50	22.50
∞	20/60	0.79	5,53	12.64	11.06	23.70
6	15/60	0.84	5.88	13.44	11.76	25.20
10	10/60	0.89	6.23	14.24	12.46	26.70
11	2/60	0.94	6.58	15.04	13.16	23.20
12 IR*		7.91	55.37	126.56	110.74	237.30
Total Res. Cont.		8.91**	62.37	142.56	124.74	267.30

*IR = Initial Residue **Use this value for Debris and Animal matter residues

DIRECT APPLICATION TO AQUATIC HABITATS FOR MOSQUITO CONTROL

The W25 (25% Wettable powder) formulation and W-25 granule (formulated by abatement district personnel using 30 pounds of W-25 formulation, 2957 pounds of 20/30 mesh coarse sand, 10 pounds of larvicide oil and 3 pounds of Hysil) will probably be used to control mosquito larvae in overflow, intermittently flooded sites associated with urban and residential areas, drainage ditches and lagoons from dairy and swine holding areas, and temporary rain and snow pools. For control of mosquito larvae including Culex, Anopheles, Psorophora, and Aedes species diflubenzuron will probably be used at the rate of 0.025-0.04 lb AI/acre of water. For aerial application, diflubenzuron will probably be applied in 0.5 to 4 gallons of water/acre and for ground application in 5-100 gallons/acre according to the type of equipment used. Repeat applications can probably be made in 7 to 9 days or as inspection indicates increase in density of 4th instar larvae or reappearance of first instar larvae in the breeding habitat. The granular formulation should be used promptly at the rate of 10 to 16 pounds per acre.

The acute effects of direct applications of diflubenzuron to aquatic habitats at application rates of 0.04 lb Al/acre (0.03 ppm in water 15 cm deep) on non-target aquatic organisms have been summarized (Table 4). Tadpole shrimp, clam shrimp, Daphnia, Mysid shrimp (Mysidopsis bahia), Gammarus, glass shrimp, Notonecta unifasciata, Brine shrimp, Midges, and May fly (Callibaetis) populations would be reduced some 50% or greater by diflubenzuron applications applied at rates used to control mosquito larvae. Field test data show that all organisms listed in Table 5 would be reduced by at least 33% as a result of one diflubenzuron application at the registration request rates of application

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e W25 (15% pounder) formulation and W-25 proxise (Pormulation & district personnel using 30 pounds of W-25 formulation, 2007 pounds of nearse sand, 16 pounds of larvesude oil and 3 pounds of hysis) will a coarse sand, 16 pounds of larvesude oil and 3 pounds of hysis) will be used to control mosquito larves an eventlow, intermittently fivedess is succeeded with whom and residential eneas, Anatherea distants in landard the sand white helding areas, and sent ordered sand pools. For mosquito larves including Suice, Anatherea, issue there is the diffluentation will probably be used at one cate of the flubentation, diffluentation diffluentation is said at the ground application is said probably as systems to the type of equipment used. Repeat applied ions or the probably he takes in describe of the first instant larvae in the heading her takes. The coarse are first instant larvae in the heading her takes. The

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Table 4. Laboratory tests - Acute toxicity of diflubenzuron to certain non-target aquatic organisms.

LC₅₀ ppm

Reference Cited	Sensitive	Reference Cited		
	Tadpole shrimp 0.0006 (24 hr) 6	r) 6	Notonecti	Notonectid 0.01 (72 hr LC_{30})
μ	Clam shrimp 0.0004 (24 hr)	თ	Callibaet	Callibaetis 0.3 (7 day)
\vdash	Daphnia 0.018 (48 hr)	ហ	Dragonfly	Dragonfly 0.05 (7 day)
2	Gammarus 0.04 (48 hr)	ഗ്വ	Hydrophil	Hydrophilid 0.1 (48 hr LC ₃₀)
ω	Glass shrimp 0.045 (48 hr)	4	Midge lar	Midge larvae 0.56 (48 hr)
			Grass shrimn 0 64	

⁵ 1. Miura and Takahashi (1974). 2. Julin and Sanders (1978). 3. Miura and Takahashi (1975). 6. Miura et al. (1975). Campt (1977). 4. Petrocelli, (1975).

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		(02) 14 1			124rophilid D.I (43 hr LCgo)	Midra larvas u.55 (48 hr)	
	2000 - 20	0aw	ent				
		MS 0.2 qminst book	Cobebbgs 30				

Table 5. Effects of diflubenzuron on non-target aquatic organisms - Field Data.

Reference Cited	<u>Organism</u>	Concentration (PPM)	% Reduction
2	Daphnia (recovered in 8 weeks)	0.003	+99
1	Copepods	0.013	50
1	Daphnia (recovered in 6 weeks)	0.013	+99
3	Daphnia (recovered in 2 weeks)	0.03	+90
4,6	Dragonfly	0.03	33 - 50
4	Notonectids	0.03	67
. 3	Laccophilus	0.03	30
4,5,6	Hydrophilids	0.03	50
2,7	Copepods	0.03	47 - 60
4	Corixidae nymphs	0.03	40
4	Hyallella azteca	0.03	57
7,5	Mayflies	0.03	50 - 64
9	Palaemonetes pugio	0.03	85
9	Uca pugnax	0.03	43
8	Cyclops sp.	0.012	100
8	Boxmina longirostris	0.012	100
8	Diaptomus sp.	0.012	• 100
8	Daphnia laevis	0.012	100
8	Ceriodaphnia	0.012	100
8	Caenis sp	0.012	99
8	Hyalella azteca	0.012	100

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 Apperson et al. (1978).
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(0.025-0.04 lb AI/acre). Field test data indicated that no organism populations shown in Table 6 were reduced by as many as 6 applications of diflubenzuron at the 0.025 lb AI/acre rate of application over an 18 month period.

DIRECT APPLICATION TO AQUATIC HABITATS BY AIRCRAFT APPLYING DIFLUBENZURON TO COTTON, SOYBEANS, AND FORESTS.

Farm ponds, lakes, rivers, or any other aquatic habitat can receive relatively heavy doses of pesticides due to inadvertent direct spray from aerial applications (Stewart et al., 1976). A worst case would be the application of diflubenzuron to an aquatic habitat at the highest rate likely in the registration for use of diflubenzuron on cotton, or for tussock moth control in forests (0.125 lb AI/acre). In this case, the aerial applicator would fail to 5 stop the application at the end of the area to be treated and continue to apply diflubenzuron at a rate of 0.125 lb AI/acre over an aquatic habitat (i.e., farm pond, drainage canal, lake, stream, etc.). This would result in a relatively high concentration of diflubenzuron being applied directly to the aquatic habitat. If the aquatic habitat was 15 cm deep, this would result in an initial concentration of 100 ppb in the total volume of water covered by the application. Fifteen centimeters of water was chosen for this example of worst case since it represents an aquatic habitat that would support some species of fish as well as other aquatic taxa. At this concentration of diflubenzuron in the aquatic habitat, certain organism populations listed in Table 4 would be effected at the LC₅₀ response level or probably above this level in some cases (tadpole shrimp, clam shrimp, Daphnia, Mysid shrimp, Gammarus, glass shrimp, notonectids, and dragonflies listed in Table 4 and all taxa listed in Table 5).

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r aquatic taxa. At this concentration of Rillubonsumen in content organism populations listed in lable 4 would be response level or probably above this level in some string, Daphnia. Lysia shrimp, Cambridge, C

Table 6. Effects of diflubenzuron on non-target aquatic organisms - Field Studies - No Population Reduction at 0.03 ppm.

Reference Cited_	<u>Organism</u>	Reference Cited	<u>Organism</u>
4,6	Midge larvae	5	<pre>copepod notonectids</pre>
4	Callibaetis	4	Hydrovatus cuspidatus
4	Physa sp.	4	Trichocorixa louisianae
4	Mesovelia mulsanti	4	
4	Caenis sp.	4	<u>Callibaetis</u> sp.
4	Noteridae	4	Hydrovatus sp.
4	Bidessini	4	Chironomidae
4	Ephydridae	4	Dolchopodidae
4	Tabanidae	4	Gambusia affinis
4	Jordanella floridae	4	Buenoa sp.
4	Berosus exiguus	4	Tropisternus laterilis
	Enochrus blatchleyi	4	Laccophilus proximus
4	Hydrocanthus sp.	4	Suphisellus sp.
4	Celina angustata	4	Onychylis nigriostris
4	Listronotus appendicu	latus 4	Lissorhoptrus sp.
4	Belostoma sp.	4	Taphromysis louisianae
4	Paleamonetes paludosu	s 4 ·	Procambarus clarki
4		4	Tropisternus sp.
4	Berosus sp.	4	Laccophilus
. 4	Enochrus sp.	4	Stratiomyiidae
4	Muscidae	4	Belonia sp.
4	Pachydiplax sp.	4	Mesovelia sp.
4	Anax sp.	4	Cambarellus sp.
4	<u>Liodessus</u> affinis	4	<u> </u>

^{4 -} Farlow et al. (1978). 5 - Mjura et al. (1975). 6 - Steelman et al. (1975).

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This treatment of the aquatic habitat represents the immediate residue level to which these non-target organisms would be exposed and does not include reduction in residue concentrations caused by dilution by untreated or running water, uptake on sediment, or breakdown of the parent compound in the treated habitat. This situation does occur in some areas likely to be treated with diflubenzuron, thus, the initial situation was presented as a worst case.

CONTAMINATION OF ADJACENT GROUND AND WATER BY DRIFT OF DIFLUBENZURON FROM AERIAL APPLICATIONS TO COTTON AND SOYBEAN FIELDS, AND FORESTS.

Farm ponds or any aquatic habitat can receive relatively heavy doses of pesticides by drift from aerial applications (Stewart et al., 1976). Based on drift deposition data derived from Yates et al. (1974), we calculate that the decrease in deposition rate with outward distance from the edge of a large crop area treated at 0.125 lb AI/acre (150 g/ha) will decrease as follows (area treated by 60 swaths):

Distance a (meters)	Deposition Rate	Cond	centration in Water ^b
	1b AI/acre	g/ha	15 cm depth in ppb
0	0.125	150	100
25	0.125	150	100
45	0.076	92	62
100	0.040	49	33
200	0.024	29	19
400	0.014	16	11
800	0.0082	10	6.7
1200	0.006	6.7	4.5

a These calculations are for the drift dispersion of a formulation of diflubenzuron in cottonseed oil, which travels about 1.5 x further than a water-based emulsion. Flight conditions as described in Table 7.

b No allowance was made for attachment of diflubenzuron to sediments.

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Table 7. Cumulative off-target drift deposits from 20, 40, and 60 adjacent 33 feet wide swaths applied with a stearman aircraft^a, b (upper 99% confidence limit).

Distance Downwind, Ft.	% of Applied Volume ^c , d				
100	(20 Swaths-1/8 mi)	(40 Swaths-1/4 mi)	(60 Swaths-3/8 mi)		
83	64.9	70.9	74.9		
149	31.5	37.4	40.9		
314	14.0	18.5	21.8		
644	6.6	9.6	12.6		
1304	3.2	5.7	7.4		
2 624	1.7	3.2	4.4		
3944	1.2	2.2	3.0		

LEDT: The off-larger drift depotits from 20. 40, and 60 sarent 31 with a steam of crafts. (urber nex

(20 Swaths-1/8 mi) (40 Swaths-1/4 mi) (21 Swat 15-37
64.5 10.9 27.4

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The water concentrations are those which would be caused by deposition of drift on the surface area of an open pond or aquatic habitat at these distances from the edge of a sprayed area; the diflubenzuron being uniformly distributed through the 15 cm depth (6 inches, total volume).

There is no allowance for removal of diflubenzuron by adsorption on organic matter or sediment in or under this aquatic habitat. Such adsorption would reduce the concentration of diflubenzuron to much lower levels.

These levels cannot be calculated without postulating given amounts of sediment, but reduction to values less than 10% of the calculated values will happen rapidly.

The drift of diflubenzuron over aquatic habitats previously discussed would result in concentrations of 6.0 ppb in water 6 inches in depth that would be acutely lethal (LC_{50}) to tadpole and clam shrimp, <u>Daphnia</u>, and mysid shrimp at a distance of 1200 meters from the edge of the treated field. At distances of 0 to 25 meters, the concentration would be 100 ppb in 6 inches of water, thus, acutely affecting tadpole and clam shrimp, <u>Daphnia</u>, mysid shrimp, <u>Gammarus</u>, glass shrimp, notonectids, dragonfly naiads, and Hydrophilid larvae (Table 4), as well as all taxa listed in Table 5.

Although information and data are not available to calculate estimates of deposits from drift of diflubenzuron during aerial application to forests, the data in Table 7, along with appropriate adjustments, can serve as a guide to expected deposit levels. Greater vegetation height and increased variability of terrain over that found in cotton and soybean applications result in greater heights of spray release and potentially increased drift. However, the screening effect of tall trees tends to reduce drift deposits at ground level (many drifting particles deposit on the foliage before they can reach the

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ground). When coupled with the low rate of application (0.0312-0.125 lb AI/acre) and the fact that only one application per season is expected for gypsy moth or tussock moth control, these factors suggest that drift deposits from forest treatments will likely be significantly lower than those for cotton or soybeans.

DIFLUBENZURON RUN-OFF FROM TREATED COTTON AND SOYBEAN FIELDS, AND FORESTS

The estimates of the concentrations of diflubenzuron that may be expected in aquatic systems affected by run-off from treated areas have been made in three ways.

- 1. By evaluation of laboratory or field residue studies dealing directly with the runoff potential of diflubenzuron.
- 2. By analogy and extrapolation from data with other pesticides. This, however, is limited to small watershed areas where actual observations exist.
- 3. Using projections based upon computer calculations with models that use inputs defining weather, streamflow, soil properties, descriptions of use patterns, and chemical properties of the pesticide. Procedurally, these calculations lead to predictions of water flow, sediment production and the amount of pesticide transported. Depending on the extent of the assumptions made, pesticide concentrations can be estimated both close to treated areas and at distances down stream channels.

data on other pesticides or on computer calculations using models are based on the same projected usage. For cotton, this is four applications of 0.0937 lb Al/acre (43 g/hectare) at seven-day intervals beginning on June 15th each

pen support with the low rate of application (0.0019-0.125 the are to fact that only one application per seas of a expected for gyrs) as a control, these fact is suggest that drift drywout from coat. Its will likely be significantly lower that those for too in

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year. The total application is thus 0.375 lb/acre (170 g/h). For soybeans two applications, each of 0.0312 lb AI/acre (14 g/h) are projected for a total of 0.0625 lb/acre (28 g/h). Maximum forest application would be one application/year at either 0.0625 (gypsy moth) or 0.125 (tussock moth) lb AI/acre. Each of these usages is consistent with the proposed label.

Laboratory and field run-off studies. Two studies are available that deal directly with the run-off potential of diflubenzuron. One of these (Gemma, 1975) was a laboratory investigation in which diflubenzuron (Dimilin W25, 1 lb AI/acre equivalent) was applied to the surface of a Missouri Valley clay loam soil in an inclined tray (10% slope). Artificial rainfall (~1.5 inches over a 2-hour period) was then provided at 1, 3, and 7 days after treatment, and the run-off water was collected and analyzed for diflubenzuron residues. The results of the analyses showed that in all cases, diflubenzuron residues in the run-off water were <0.01 ppm.

A recent study by Collins (1978), reported the levels of diflubenzuron in water (Chowan County, North Carolina) resulting from diflubenzuron's use in the pilot boll weevil eradication program. Water samples were collected from several streams and tributaries receiving run-off from diflubenzuron-treated cotton fields, and were analyzed for diflubenzuron residues. The fields had received as many as 16 treatments of diflubenzuron during 1976-77 (0.03-0.06 lb AI/acre/treatment), with application of the 25 WP formulation made by fixed-wing aircraft. Analysis of numerous water samples (collected during 1977) showed that residues were in all cases <0.005 ppm diflubenzuron, the sensitivity of the analysis procedure.

Comparison with other pesticides. The potential runoff of diflubenzuron was considered in light of available data on other pesticides. In the case of cotton, since diflubenzuron will be applied to a closed canopy of mature cotton

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Secret study by Collins (1978), reported the lovels of diffuserable in the county, Routh Carolina) resulting from diffuserable uses to the season of the collected from the week and tributantes receiving numbers from diffuserance-tree to the season were analyzed for diffuserance mestables. The fields had a season of the formulation model (0.03-0.05 had because of the county), with application of the 25 up formulation mode by sixed-official and the collected during 1970) showed any season of the collected during 1971) showed as were a glace of collected during 1971) showed as were a glace of collected during 1971) showed as were a glace of collected during 1971) showed

esticities. The potential runoff of diffichenzeron wattable is a on other posticide. In the case of

plants, it is assumed that 30% reaches the soil directly. Bull and Ivie (1978) showed that 23% remained on the leaves 21 days after application, following a heavy rain. We therefore assume that 75% would wash off, so that for each application of 43 g/h, we should have

Initially on soil	12 g
Initially on pTants	3 0 g
Wash-off (30 \times 0.75)	23 g
Total on soil for run-off	36 g

Assuming the half-life of diflubenzuron on the soil to be 7 days, the amount present on the soil after the last application to cotton will be 67.5 g/hectare (36 + 18 + 9 + 4.5). Applications to soybeans will be less regular in time, but it may be assumed that there would be about 20 g/hectare after a second appliction. Choosing a worst possible case from Stewart et al. (1976), as shown in Table 8, we may envision losses up to 10-15% of that on the soil in heavy run-off from cotton or soybeans grown on steep land (15% slope). On more representative cropland areas (5% slope or less), the worst probable loss is not likely to exceed 1% of soil residues. On this basis, we calculate:

The manufactured that 20% reaches the soil affect and the the charter on the issues 21 days error application, Parlunds 2 its. We therefore assume that 75% would now to the formations assume that 75% would now to the first or the charter or assume that 75% would now to the first or the firs

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exceed 13 of soil residuos. On this besis, we chestage

Percentages of applied pesticides lost in runoff^a in field experiments^b Table 8.

Citation	Saincitt bar aufurd	Ritter et al. (134)	Freeman,	et al. (al. (35)	ey, Sheets, a	ein and (Caro et al. (34)	t = 34	_	n and Grant (63		(167)	, Bradley, and	, Bradley, and Jackson (et al. (134)	y, Sheets, and Jackson (1	Sheets, Bradley, and Jackson (142)	Sheets, Bradley, and Jackson (142)	
Pesticide in runoff (% of appl.)	4.8-5.0	2 5-15 9	•	6.0	1.9	1.0-2.8	0.7	2.3	0.02	0.25-0.35	0.01-1.0	0.1	<3.0	0.0	0.13-0.25	3.1	0.4-0.6	0.3-0.5	0.5-0.8	
Slope %	14	10-15	10	6	10	2-4	∞	14	10	ထ	ఐ	0.2	0.1-4	4	2	10-15	2-4	4	2	
Soil Texture] ty	Silty clay loam		Silt loam	Silt loam	Loamy sand	Gravelly loam	Silt loam	Silt loam	Gravelly loam	Gravelly loam	Silty clay loam	Various	Loamy sand	Sandy loam	Silt loam	Loamy sand	Loamy sand	Sandy loam	
Incorporated Depth (inches	0) c	0 0	က	2	0	0	m	m	0	0	0	0	0,	0	0	0	9	9	
Pesticide [Atrazine	Atrazine	Carbary	Carbofuran	Carbofuran	TCa	Too		Dieldrin	Endosul fan	Endrin	Endrin	Fluometuron	Methyl parathion			Toxaphene	Trifiualin	Trifluralin	

^aBoth water and sediment. ^bFrom Stewart et al. (1976). ^cSee Stewart et al. (1976) for complete reference citations.

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Crop	Soil Residues (g/h)	<u>1% loss</u>	10-15% loss
		g/hectare	
Cotton	67.5	0.7	7 - 11
Soybeans	20	0.2	2 - 3

If these totals are carried in 1" of run-off water (2.5 cm), the projected concentrations will be:

Crop	Overall concen-	trations (ppb)
<u> </u>	1% loss	10-15% los
Cotton	2.8	28 - 44
Soybeans	0.8	8 - 12

Transport of the same amounts in less water would give proportionally higher concentrations, and it is conceivable that if the assumptions forming the basis of these calculations are correct, concentrations could approach 100 ppb in run-off from very steep land.

Calculation of the distribution of this total diflubenzuron between water and sediment would require assumptions about sediment concentration in the

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run-off and also its particle size distribution. Since these are uncertain numbers that change rapidly with time, projection of this distribution for the rapidly changing situation at the foot of the field is without significance. Adsorption of diflubenzuron by sediments is, however, of more significance in long-distance transport.

These calculations may be compared with earlier experience with residues of other pesticides that has shown that concentrations of pesticide residues in the waters of farm ponds located adjacent to treated cropland areas are correlated with the amount of pesticide applied in the area and the length of time between the application and the first heavy rain. Data have been published which indicate that pesticide concentrations in ponds located near cotton fields were significant after application and especially high when intense rain closely followed the application. Pesticide concentrations in these aquatic habitats were high (55-184 ppb) if the first rainfall occurred within 2 weeks after application. By contrast, if the first rainfall occurred 6 weeks after application, the pesticide residues were only 2-29 ppb. There are also reports that indicate that farm ponds are not always contaminated from rainfall run-off pesticide residues even when adjacent to treated croplands (Stewart et al., 1976).

If, following Nimmo and de Wilde (1975), we assume a decrease in difflubenzuron residues in cotton fields with a half life of 1 week, residues will be down to about 25% of the applied concentration by July or August. Bull and Ivie (1978) reported that there was little further decline in residues over the winter. If the soil remains undisturbed without plowing or cultivation, we may therefore assume that erosion in the late winter or early spring would release up to 20% of a similar event to that which had occurred 9-10 months earlier. The predicted values in this second event would then be 1/5 of those

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lose calculations may be compared with equivar experience with magicias of mesticide (mat has shown that concentrations of nesticide relations) of farm pends located adjusted in the area and the length of the Desticide applies in the area and the length of the Desticide and the first heavy rains. Data have been published which is the pesticide concentrations in mands occasion may out on the interval and especially high when totices in a closely and the application. Perticide concentration is a basic aguar on a standard of the application. Perticide concentration is a basic aguar on a standard on the pesticide residue; were only 2-29 pph. There are also in dies that farm ponds are not always contemicated that rainfall remove dies that farm ponds are not always contemicated that rainfall remove the residues even when adjacent its treated complexies (Clouert et al.).

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the late winter or early spran uesdit to that we course be the months of second event would then be 175 of the

calculated for immediate rainfall run-off. However, if the soil is plowed or cultivated, the winter or spring losses will be much less. Assuming that the residues were present in the top 1 cm of soil before plowing and are uniformly distributed through the 15 cm depth afterward (= 15 x dilution), the fraction of the original application remaining on the surface and liable to loss in run-off in the late winter or spring would be no greater than 1.3% (= 20%/15) of that lost in a similar event 9-10 months earlier. The predicted concentrations for this second event would then be between 1 and 2 % of those calculated for immediate run-off. If the diflubenzuron were not uniformly mixed to the 15 cm depth, but wholly buried by the inversion of the topsoil during plowing, the concentrations would not exceed 0.1% of those in immediate run-off.

The use of diflubenzuron in forest insect control will often be associated with lands of considerably greater slope than in the case with cotton and soybean production, but there are no experimental data to indicate the extent of run-off from treated forests. However, application rates on forests are low with respect to the potential application rates on cotton, and it is known that diflubenzuron adsorbs strongly onto organic matter (Nye, 1977). Thus, the high organic content of the forest floor should minimize run-off from these environments.

# PROJECTION OF RUN-OFF AND TRANSPORT USING MATHEMATICAL MODELS

Since there are essentially no observational data available on the long-distance transport of pesticide residues down stream channels after individual run-off events, no projections for diflubenzuron based on the behavior of other chemicals are possible. However, a mathematical approach for projecting diflubenzuron loadings and concentrations in several river systems has been taken using Version II of the USEPA Agricultural Run-off Management (ARM) Model

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developed by Donigan et al. (1977). This calculation gives projections of diflubenzuron concentrations entering streams at the point of field discharge into streams. This, coupled with calculations of dilution, transport, and degradation in the mainstream flow further permits calculation of projected concentrations and persistence of diflubenzuron at downstream points remote from the application areas. Complete details of the calculation and results are available (Falco et al., 1978). The immediate discussion that follows will be confined to a presentation of the principal results and a discussion of the significance of the results in terms of the assumptions made.

Areas Selected. Calculations were completed for the drainage basins of the Tombigbee, Brazos, Colorado, Atchafalaya, and Nueces rivers, all of which drain directly into the Gulf of Mexico, and for the lower Mississippi, comprising the St. Francis, Arkansas, White, Yazoo, and Big Black rivers. All were chosen because they contain large cotton and soybean acreages and have high potential for run-off. The results of similar calculations for the Rio Grande, Trinity, and Pearl rivers were not used in the final analyses for reasons discussed below.

Selected Cropping Patterns. The calculation was performed assuming that diflubenzuron would be applied to cotton alone, and repeated assuming that both cotton and soybeans would be treated. Total acreages for both crops in each basin were estimated from data supplied by State Reporting Services. It was further assumed that the entire crop in each watershed would be treated according to the schedule described above; no allowance was made for the possible effects of partial treatment of the land area, or variations in application schedules. This assumption was necessary to keep the amount of computation within the practical limits and to avoid excessive proliferation of output results.

ed Croquing Patherns. The calculation was performed assuming that a would be applied to cotton alone, and repeated assuming that he ybeans would be treated. Total acrossus for both crops in each estimated from data supplied by State Reporting Services. It was smied that the entire crop in each astersland would Til treated to the subcourse describe above; he allowence was made for the concerns describe above; he allowence was made for the concerns describe above; he allowence was made for the sanctual treater.

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Weather Conditions. The rainfall and evaporation patterns over all the river basins were assumed to be those reported for Beeville, Texas. This location was the only suitable reporting station for which sufficient data were readily available. Calculations were run with rainfall patterns for each year from 1971 to 1975. The error in the estimates arising from the assumption that it rained everywhere in all the basins at the same time and with the same intensity and duration is thus partially offset by the range of conditions experienced over these years. It may be noted that the occurrence of an unusually heavy storm in 1971 permits the inclusion of the calculated consequences of such an event.

Stream flow data. Daily observations of stream flow data from 1971 to 1975 used in the calculation of stream dilution and transport were obtained from United States Geological Survey files; no calculation was performed where data did not exist. Estimated times of travel for each river were obtained from the United States Army Corps of Engineers.

Soil Stability and Hydrologic Characteristics. The necessary parameters describing soil behavior and effects of crop management on run-off and erodibility were obtained from United States Soil Conservation Service data.

Details of these model inputs, together with those for crop areas, stream flow, sediment loads, and travel times are available (Falco et al., 1978).

## CALCULATED CONCENTRATIONS IN COASTAL DISCHARGES

The maximum projected daily concentrations in the water at the mouths of rivers, assuming the weather patterns of 1971 through 1975, are presented in Table 9. Table 10 contains the average daily concentrations for the summer of each year at the same locations. Both Tables contain separate estimates for loadings caused by applications to cotton alone and by applications to cotton

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Table 9. Maximum estimated daily diflubenzuron concentrations at river mouths for 1971 through 1975^a

Basin	Year	Diflubenzuron Concentration (ppb)								
503111		-Cotton	Cotton & Soybeans							
Mississippi	1971	1.8	3.2							
Atchafalaya	<b>1</b> 971	2.1	3.6							
Tombigbee	1972	0.2	0.8							
Brazos	1974	3.7	3.7							
Colorado	<b>1</b> 971	14	27							
Nueces	1975	38	38							
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Table 10. Average estimated daily summer concentrations of diflubenzuron at river mouths for 1971 through 1975.

Basin	Year	Diflubenzuron Concentration (ppb)							
		Cotton	Cotton & Soybeans						
Mississippi	1971	0.20	0.34						
	1972	0.09	0.15						
	1973	0.11	0.19						
	1974	0.06	0.11						
	1975	0.05	0.08						
Atchafalaya	1971	0.29	0.50						
	1972	0.13	0.23						
	1973	0.11	0.20						
Tombigbee	1971	0.03	0.12						
	1972	0.05	0.16						
	1973	0.05	0.15						
	1974	0.02	0.06						
	1975	0.01	0.03						
Brazos	1973	0.49	0.52						
	1974	0.71	0.71						
	1975	0.29	0.29						
Colorado	1971	1.46	2.04						
	1972	1.31	1.84						
	1973	0.41	0.56						
	1974	0.20	0.28						
	1975	0.08	0.12						
Nueces	1973 1974 1975	1.28 0.83 1.20	-						

afrom Falco et al. (1978).

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83.0 19.0 19.0	0.62 0.73 0.73		
2.0.2 48. 61.0 61.0	24.1 10.1 10.0 05.0 80.0	1972 1972 1972 1975	
e e	1.20 0.83 1.20		

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and soybeans taken together.

Data for the Rio Grande are not included because the rainfall patterns at Beeville, Texas were probably not representative of this river, whose flow is also greatly modified by diversions. Satisfactory projections for this stream would require a special calculation using input specific to the area.

Results for the Trinity and Pearl, rivers were also excluded, because both streams pass through flow control reservoirs in their lower reaches.

Calculation of the effects of sediment retention and water residence time in these structures were impracticable within the present computer model.

Table 11 contains a calculation of the frequency with which the estimated concentrations exceeded the stated levels at the mouths of three selected rivers. Data for the Mississippi and Tombigbee are calculated over five and the Brazos over three years. These basins were selected to represent three different conditions — the Brazos as principally a cotton growing area, with a relatively low soybean acreage in contrast to the Tombigbee where soybeans predominate. The Mississippi was selected as the geographically largest. Complete data, including cotton acreages, can be found in Falco et al., (1978).

## CALCULATED RUN-OFF FROM FIELDS

The computed diflubenzuron concentrations discharged to the river from the cotton fields of the Yazoo basin under 1971 and 1973 weather patterns were found to be, assuming applications of 0.125 lb/AI/acre:

Frequency of periods where estimated diflubenzuron concentrations exceeded stated levels for given durations over three or five year sequences (discharges from cotton only). ^a Table 11.

	41-60		•	<b>→</b>				•	<b>⊣</b>			<b></b> 1	⊷	
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		Five Ye	7	15	\$ ( >	של ה ה ה	) «	14	15	Years)	9	ĸ	6	
200000000000000000000000000000000000000	(pbp)	Mississippi (Five Years)	0.1	0.01		10001goge (rive lears)	) ·	0.1	0.01	Brazos (Three Years)	0.1		0.01	

afrom Falco et al. (1978).

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		Year	
	•	1971	1973
Concentration range (ppb)		0.03 - 85	0.05 - 115
Mean		15	11
Median		1.5	4.0
Number of events		13	25

Comparison of these figures with those above reveals a wider range of predicted concentrations, probably reflecting the range of predicted volumes of run-off water. Allowing for the assumption that the earlier concentrations were based upon 2.5 cm of run-off, the agreement between the two sets of estimates are excellent, indicating that diflubenzuron concentrations in water directly discharged from cotton fields is likely to range from very low values to about 100 ppb. The difference between the median and mean values indicates that the latter are heavily weighted by relatively few high values and that concentrations will not exceed about 4 or 5 ppb during one half the events that take place.

Since diflubenzruon is adsorbed by sediments and a number of benthic organisms which may be affected are crustaceans, the concentration of diflubenzuron on sediments deposited in the estuaries may be important. A convenient approximate estimate of the concentrations (in ppm) on the sediments may be obtained by multiplying the concentrations of Table 10 by the

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on 2.5 cm of run off, the agreement between the common of run interpretations of the difference difference that difflubenzuron concentrations of water directly edifference between the median and mean values indicates that the

e heavily weighted by relatively law into values one tolf the events its

ch may be affected are crustaceans, the concentration of

ng concentrations (in ppm) on the erdinesha

off you life and a

distribution coefficient (x 2000). This assumes that the sediment consists of 50% organic matter and the adsorption isotherm corresponds to that given by Carringer et al. (1975). The results of this calculation are given by Falco et al. (1978).

### INTERPRETATION

The estimates show marked differences between river basins and also diferences reflecting the applications to soybeans. Highest estimated diflubenzuron concentrations and largest frequencies are indicated for the Nueces, Colorado, and Brazos rivers, suggesting that the largest imput of diflubenzuron is likely to be found in the estuaries of the rivers on the western Gulf Coast. While the analysis has not been performed, it is possible that this may reflect the greater sensitivity of the flow of these rivers to rainfall on the Coastal Plain. Estimated concentrations at the mouths of the Mississippi and Tombigbee are generally lower; this may perhaps reflect dilution of the diflubenzuron by run-off from a relatively greater proportion of untreated land. Complete interpretations of these differences will, however, depend upon full analysis of the factors used in the modeling projections.

In evaluating the diflubenzuron concentrations projected by the modeling process, it is essential that the uncertainties introduced by the basic assumptions should be borne constantly in mind. Three of these are of particular importance. All are likely to lead to overestimates of the amounts and concentrations of diflubenzuron transported away from the areas of application.

The assumption that the weather patterns over all the basins are always the same in time and intensity as those of Beeville, Texas, leads to the projection that run-off will tend to take place from all the fields in all the basins at the same time. This is clearly a condition that needs further study. Except for major

witig conflictors (a 2000). This eriamon that the endimed consists of safe motter and the adsorption esothern correspond to the groundry at al. (1975). The results of this colculation are given by as

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storms of hurricane proportions, heavy summer rainfall in the cotton and soybean belts is most frequently associated with localized thunderstorms. While considerable run-off may occur in such storms, the active area at any one time will be a small fraction of the whole.

The model assumes that the entire cotton acreage is treated with diflubenzuron at uniform rates on an idealized schedule. This projection does not conform to normal use practices for pesticides. White much may be treated at once, large areas may be treated at lower rates or frequencies, further reducing the chances of large scale run-off of freshly applied material from the entire cropped area.

Thirdly, the model assumes that all run-off from the entire treated area is directly discharged to flowing streams for immediate continuous transport by rivers. No allowance is made for delays in movement over swales, ditches, or drainage systems, or for the retention capacity of these in holding back run-off for considerable periods of time. Major reductions in diflubenzuron concentrations will take place where this occurs due to adsorption on untreated soil and by chemical degradation during the delay. All these assumptions tend to increase the estimates of the amounts of diflubenzuron that may potentially be moved away from the target areas. In the absence of any observational data to validate the model, the size of the factors to correct them are unknown so that the estimates presented in Tables 9, 10, 11, and additional data in Falco et al. (1978) must be viewed with considerable reserve.

Modeling projections of the levels of diflubenzuron or any other pesticide that might be discharged by major river systems would need to be reserved until such projections are varified by valid, measured scientific parameters.

In the case of diflubenzuron, there are no data indicating to what extent, if at all, the compound might leave the area of application via run-off, nor is there documented evidence that the proposed uses of diflubenzuron will

eas proportion beary success water? I so the cotton and sever an frequency ossection with local and includeratorms. If in pun-off may occur in such storms, the active area at an our class, small fraction . The whole.

To model assumes that the entire cotton acreage is trooped with ensured at uniform rates on an idealized schedule. This projection to the projection of uniform rates on pesticides. While much me, is treated at lover pates or frequent as.

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ions will take place where this occurs we so accur? on universal by chemical degradation during the delay. All these assumptions reache estimates of the amounts of diffubenceron that may potentially ay from the target areas. In the absence of any observational dainer me model, the size of the factors in correct them are unknown so set mates presented in tables 9, 10, 11, and additional data to False estimates the viewed but monthership presented in tables 9, 10, 11, and additional data to False.

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result in any residues being discharged into estuarine or salt water environments. Thus, the possibility that diflubenzuron may interact with any organisms in such environments needs at this point to be viewed as problematical.

THE MOUTHS OF RIVER BASINS BY MATHEMATICAL MODELS

Projected diflubenzuron concentrations at the mouths of several river systems draining cotton and/or soybean acreage were calculated using Version II of EPA Agricultural Run-off Management (ARM) Model (Donigan et al., 1977) as developed by Falco et al. (1978).

The present assessment excluded the effects of diflubenzuron on non-target aquatic organisms in the various river systems from the time that diflubenzuron entered the river systems as watershed run-off until it reached the mouth of the river systems. No predicted levels of diflubenzuron at various points down river from the point of entry were produced by the USEPA Model. Also, the assessment team did not have access to any literature relative to the effects of diflubenzuron on riverside species. The projected effects of diflubenzuron on non-target aquatic organisms at the mouths of the Mississippi, Atchafalaya, Tombigbee, Brazos, Nueces, and Rio, Grande Rivers were determined using the data obtained from the ARM model.

In assessment of the effects of diflubenzuron contained in water potentially moving through the various watersheds, the USEPA model assumed that the entire acreage of both cotton and soybeans would be treated. It is important to understand that: 1) no assumption was made in which partial treatment of this acreage would occur (under no circumstances would all of the cotton and soybean acreage be treated with diflubenzuron); 2) no consideration was made of the fact that the treated acreage would not receive applications of

a larg residues haing discipanced into eclulating or sett which and weeks. Thus, the possibility that diffuberarum on, interact with any me in such environments needs at this point to be viewed as prollegation.

TS OF DIFFLUE BRITISHED ON HON-TAGEST ON WASHING OF LEVEL PRODUCTS OF PLVER BASINS BY MATHEMATICAL MUNELS

ojected dif benzumon concentrations at the mouths - several sinup cotton and/or soybean acreads were malsulated using Vermi Maricultural Run-off Management (ARM) Model (Jonies et et., 1977) -s by Falco et al. (1978).

ne present assessment excluded the effects of diffubers or not terms in the various river systems from the time that diffuse when define angulars of the first systems as watershow neoff until it reached the nouth of the yetems has predicted levels of diffusence on at various points door come the point of entry were produced by the USEPA Model. Also, we ment team did not have access to any literature relative to the nauron on riverside species. The projected effects of diffuse appearance organisms at the mouths of the Mississippi, Atchafalaya, austic organisms at the mouths of the Mississippi, Atchafalaya, apatic organisms at the mouths of the Mississippi, Atchafalaya,

session of the effects of diflubenzaron contained in water

the moving through the various materialeds, the USTPA model assumed 2003

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assumption was made in which paraisl

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diflubenzuuron on a more representative use schedule (it is known that differences in plant varieties, soil conditions, climatic conditions, and pest populations, as well as other varibles, could cause tremendous variations in the diflubenzuron application schedules); and 3) no assumption was made concerning the rate at which the potentially contaminated watershed water from the various river basins would mix with the sea water at the mouths of the river systems (the influence of tidal flow at the mouths of the rivers would be great relative to whether or not the contaminated river water remained in the main river channel or whether or not it was pushed and dispersed through the marsh areas on either side of the main channel at the mouth of the river).

Outflow of water from the marsh areas is also greatly influenced by wind speed and direction in that wind from the north tends to push water out of the marsh, while south winds tend to push water into the marsh or, in many cases, hold water in the marsh. Adequate reference has been included in a previous section regarding the USEPA models assumptions regarding weather conditions, stream flow data, and soil stability and hydrologic characteristics.

Following a review of the data reported on studies of diflubenzuron, the assessment committee agreed that 5 species of non-target aquatic organisms, if present in the habitat receiving water that contained diflubenzuron, would be sensitive to relatively low concentrations of the compound (0.2-2.0 ppb). The five species are: Mysid shrimp (Mysidopsis bahia), grass shrimp (Palaemonetes pugio), blue crab (Callinectes sapidus), marsh crab (Sesarma reticulatum), and brine shrimp (Artemia salina).

The data in Tables 12-15 show the combined data from the USEPA model and the published concentrations of diflubenzuron that effect the 5 non-target organisms indicated. The data in these tables need no explanation other than the fact that if, as the EPA model predicts, the listed concentrations of

n a mo representative and echedula (it is home that differences related, soil conditions, olimeta; conductors, and rest paper only a establishment of establishment of the respective relations of the respective rate from the various ravey begins the the sea water at the months of the ravers would be great relative to whether or only months of the rivers would be great relative to whether or pushed and disper little main river chancel or whether a pushed and disper little main river chancel or whether a pushed and disper little through the main river chancel or whether and the mouth of the river).

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In the march. Adequate reference has been included in a previous regarding the USEPA code is assumptions regarding worther conditions.

offowier a review of the data reported on studies of flubonships in ent committee agreet that Superies of non-ineget agus ordering, would be a the babitat receiving water that contained diffuber suron, would be a to atively low concentrations of the compand (0.2-2.0 agus in an army Mysid shring (Mysidopuis babis grass through (Ps) agranate cast (Sosage rejiculation) and cast (Sosage rejiculation) and

slow the combined sata from the USEDA medal has and all the combined that of education contents that the financial and the complete that the financial of the first send and explanation other than all projects, the listen concentrations of

five river basins resulting from applications at maximum rates of 0.75 lb AI/acre/season to cotton and 0.125 lb Summer concentrations and effects of diflubenzuron on non-target aquatic organisms at the mouth of AI/acre/season to soybeans. Table 12.

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Concentration diflubenzuron in River water	d shrimp idopsis bahia	Grass shrimp Palaemonetes pugio		crab Ta	Brine shrimp Artenia Salina
Year Aa PPS Bb	>0.2	>0.45	>0.5	>1.0	>2.0
sissippi River B	>	>	>		
72 0.49 0.3	× ×	<	<		
73 0.63 0.3	×:				
1974 0.34 0.21 1975 0.25 0.16	×				
schafalaya River B					
971 1.6 0.9	× :	×:	×		
0, 1	× >	×			
7/3 U.05 U.41	<			•	
27 0 43 0 7	×				
972 0.56 0.	: ×				٠
973 0.55 0.3	<b>×</b>				
974 0.20 0.1					
9/5 0.10 0.0					
273 1.4 Das 11.0	×	×	×	×	
974 1.9 1.	×	×	×	×	
975 0.77 0.5	×	×	×		
olorado River Basi		. :	;	:	. >
971 6.2 4.1	<b>:</b>	<b>×</b> :	>< ;	×	× >
972 5.6 3.7	× >	× >	× >	× >	~
9/3 1./	<b>«</b> >	< <b>&gt;</b>	< >	<	
9/4 0.85 0.5	< >	<	<		
975 0.36 0.2	<				

^aData generated ARM-EPA lab, Athens, Ga. -- See Falco et al. (1978) (0.250 lb AI/acre for 4 applications at 7 day intervals). ^bARM-EPA data corrected to show concentrations of diflubenzuron resulting from treatment of cotton and soybeans at maximum rates = combined rate of 0.875 lb AI/Acre/season

Table 13. Summer concentrations and effects of diflubenzuron on non-target aquatic organisms at the mouth of five river basins resulting from applications at expected application rates (Cotton - 0.475 lb AI/acre/season = 4 applications of 0.0938 lb AI/acre and soybean - 0.0625 lb AI/acre/season = 2 applications of 0.0312 lb AI/acre).

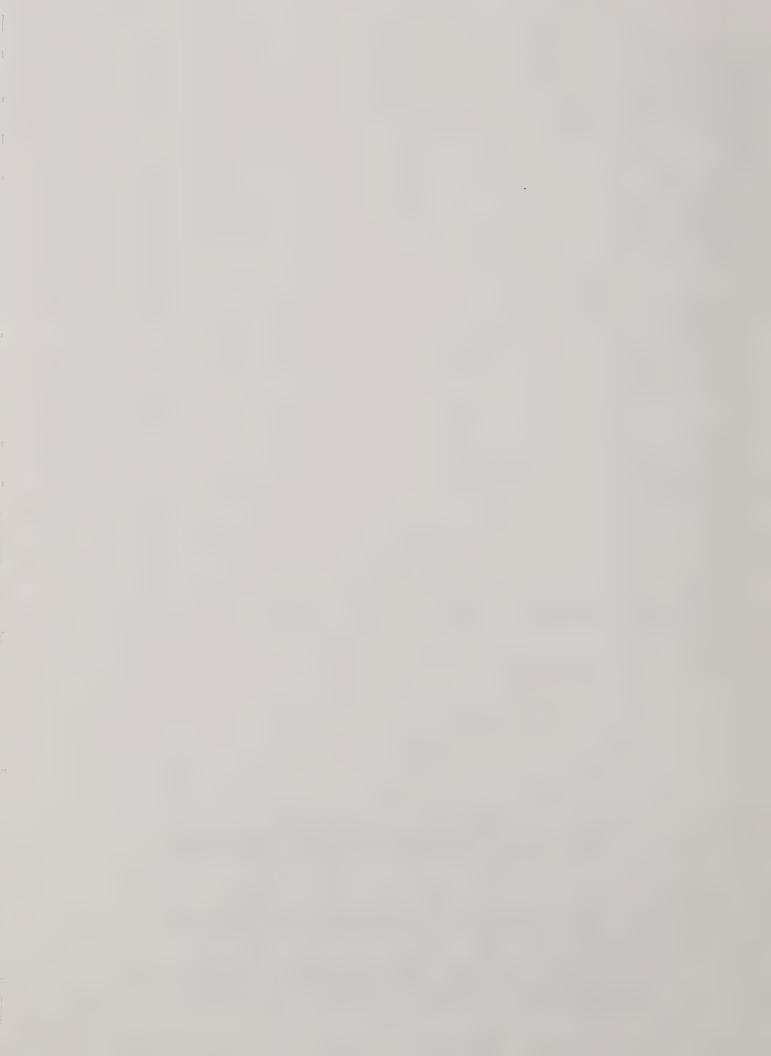
1000 1 100 100 100 100 100 100 100 100	Mysidopsis Palaemonetes Callinectes Sesarma bahia pugio sapidus reticulatum	<u>≥0.2</u> <u>&gt;0.45</u> <u>≥0.5</u> <u>≥0.5</u> <u>≥1.0</u> <u>&gt;2.0</u>	n' ×	•	×	,		×× ××	× × × × × × × × × × × × × × × × × × ×	: :
			ssissippi River Bas 71 1.1 0.34 72 0.49 0.15	73 0.63 0.19 74 0.34 0.11 75 0.25 0.08	chatalaya Kiver Basi 71 1.6 0.50 72 0.75 0.23	e River Bas 43 0.1 .56 0.1	974 0.20 0.0 975 0.10 0.0	373 1.4 0.3 374 1.9 0.3 375 0.77 0.	olorado River Ba 971 6.2 2 972 5.6 1	974 0.85 0.075 0.00 0.00 0.00 0.00 0.00 0.00 0.

^afrom Falco et al. (1978). ^bARM-EPA data corrected to show concentrations of diflubenzuron resulting from treatment of Cotton and Soybeans at expected use rate = combined rate of 7 oz AI/acre/season.

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Table 14. Summer concentrations and effects of diflubenzuron on non-target aquatic organisms at the mouth of 7 river basins resulting from applications at the expected rates of application on cotton (0.75 lb AI/acre/season).

Brine shrimp Artemia Salina		
Marsh crab Sesarma reticulatum	•	××
which non-target Blue crab Callinectes sapidus ppb	×	· × ××
diflubenzuron at w Grass shrimp Palaemonetes pugio	×	×× ××
Levels of d Mysid shrimp Mysidopsis bahia  >0.2	× × ×××	××× ××××
Concentrations diflubenzuron in River water Year Aa Ppb	River 0.00000000000000000000000000000000000	974 0.04 0.0 975 0.03 0.0 673 0.9 974 1.9 1.4 975 0.76 0.5 971 3.9 2.9 972 3.5 2.6 974 0.53 0.4 975 0.22 0.1



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affected Brine shrimp Artemia salina	>2.0	× × ×
organisms are Marsh crab Sesarma reticulatum	>1.0	××× ×
which non-target Blue crab Callinectes Sapidus	>0.5	××× ×× ×
Levels of diflubenzuron at which non-target organisms are affected id shrimp Grass shrimp Blue crab Marsh crab Brine s sidopsis Palaemonetes Callinectes Sesarma Artem Sahia pugio sapidus reticulatum sali	>0.45	××× ××××
Levels of d Mysid shrimp Mysidopsis bahia	>0.2	××× ××××
Concentrations diflubenzuron in River water	qe	Nueres River Basin 1973 3.4 2.55 1974 2.2 1.65 1975 3.2 2.4 Rio Grande River Basin 1971 17 12.75 1972 1.3 0.98 1972 0.62 0.47 1973 0.62 0.47 1975 0.04 0.03
Conc	Year Ad	Nueres River Basin 1973 3.4 2. 1974 2.2 1. 1975 3.2 2. Rio Grande River B 1971 17 12. 1972 1.3 0. 1974 1.1 0.

abata generated ARM-EPA lab, Athens, GA. barm-EPA data corrected to show concentrations of diflubenzuron resulting from treatment of cotton at maximum rate (0.75 lb AI/acre/season) -- The use of 4 applications of 0.1875 lb AI/acre at 7 day intervals rather than 6 applications of 0.125 lb AI/acre at 7 day intervals to attain the maximum amount of diflubenzuron (0.75 lb AI/acre) permitted per year.

Table 15. Summer concentrations and effects of diflubenzuron on non-target aquatic organisms at the mouth of 7 river basins resulting from applications at the expected rates of application on cotton (0.375 lb AI/acre/season).

Artemia Artemia Salina		·	58
Aarsh crab Sesarma reticulatum	•		××
which non-target Blue crab Callinectes Sapidus ppb	•	×	××
diflubenzuron at w Grass shrimp Palaemonetes pugio		××	××
Mysid shrimp Mysidopsis bahia  >0.2	× ×	×××	××××
Concentrations diflubenzuron in River water ppb ear A ^a Bb	o.53 0.23 0.29 0.16 0.16 0.35 0.30 0.09 0.12 0.09 0.012	373 1.3 0.49 374 1.9 0.71 375 0.76 0.29	olorado River Bas 971 3.9 1. 972 3.5 1. 973 1.1 0. 974 0.53 0.



Table 15. Continued

Concentrations	Levels of d Mysid shrimp Mysidonsis	Levels of diflubenzuron at which non-target organisms are affected id shrimp Grass shrimp Blue crab Marsh crab Brine sidonsis Palaemonetes Callinectes Sesarma Artem	which non-target Blue crab Callinectes	organisms are Marsh crab Sesarma	affected Brine shrimp Artemia
River water pob.	bahia	oigud	sapidus	reticulatum	salina
Aa ''Bb.	<u>&gt;0.2</u>	<u>&gt;0.45</u>	>0.5	>1.0	>2.0
Nueces River Basin 1973 3.4 1.28	×	· ×	×	×	
2.2 0.82	×	×	×	:	
3.2 1.20	×	×	×	×	
Rio Grande River Basin			:	:	3
17 6.33	×	×	×	×	<b>×</b>
1.3 0.49	×	×			
0.62 0.23	×				
1.1 0.41	×				
0.04 0.015					

^aData generated ARM-EPA lab, Athens, Ga. ^bARM-EPA data corrected to show concentrations of diflubenzuron resulting from treatment of cotton at expected use rate (0.375 lb AI/acre/season) -- The rate of 4 applications in the ARM model has required the use of 4 applications of 0.0937 lb AI/acre rather than the expected use of 6 applications of 0.0625 lb AI/acre, to attain the total expected amount of diflubenzuron per

diflubenzuron did in fact arrive at the estuarine areas of the various river systems, a reduction in the listed organisms would occur as indicated in Tables 12-15.

Discussion is pertinent, however, when comparing the Model predictions for the various use rates on cotton and/or soybeans and the resulting potential effects on the non-target organism populations. Considerable difference exists between the effects of diflubenzuron on the non-target populations exposed to run-off water where the maximum amount of diflubenzuron requested for registration would be applied (as utilized by the USEPA Model stipulations) and that of the expected use rates. Mysid shrimp, due to their extreme sensitivity to diflubenzuron, would be affected during some years in all of the river systems, regardless of the use rate, except in the Tombigbee River where only the maximum use rate permitted by the cotton and soybean labels (0.875 lb AI/acre/season total for cotton and soybeans) caused effects. As diflubenzuron use rates were adjusted to the expected use rates for cotton and/or soybeans, the effects on the 5 non-target species were reduced in the Mississippi, Atachafalaya, and Tombigbee River Basins. However, all 5 non-target populations . were affected to some extent during certain years in the Brazos, Colorado, Nueces, and Rio Grande River Basins, regardless of use rates.

From the scientific data available, it is clear that if the concentrations of diflubenzuron estimated by the USEPA Model were to be present in water reaching the mouths of the various rivers that certain non-target organism populations would be reduced. This effect would probably be quite severe if the data continued in the USEPA Model-frequency tables are representative. Prolonged exposure to diflubenzuron (past the time of acute affects and into time intervals of exposure causing chronic exposure effects) at the

אול אם המבו בדרועם על להפ מפתרפולויי ואינטין סוף ואם יסר פעם וער מינים וויים מפונונים וויים ומפונויים וויים מפונונים מפונונים וויים מפונונים וויים מפונונים וויים מפונונים וויים מפונונים מפונונים וויים מפונונים וויים מפונונים מפונונים וויים מפונונים מפונונים וויים מפונונים וויים מפונונים וויים מפונונים וויים מפונונים וויים מפונונים מפונונים וויים מפונונים מפונים מפונ

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concentrations estimated by the USEPA Model might well temporarily eliminate total populations of some of these organisms from those habitats affected. This would depend on the species involved and the stage of life cycle in which the organism was at the time the exposure was initiated, as well as the time interval prior to change from one stage to the next stage. Long periods of exposure to diflubenzuron at the concentrations estimated by the USEPA Model would increase the probability of the organism opening its "activity window" for the natural hormone (growth regulator) process to proceed in the development of the organism. Therefore, diflubenzuron (its mode of action is involved with chitin inhibition) would be available for longer periods at concentrations sufficient to disrupt the natural and successful change from one developmental stage to the next. This event could place more importance on chronic effects than on the acute effects.

Therefore, it is of the greatest importance to completely understand and appreciate the uncertainties of the diflubenzuron concentrations that were projected by the USEPA Model. The following points must be evaluated along with any decision made relative to the exposure of non-target aquatic organisms to the projected concentrations of diflubenzuron contained in water at the mouths of the river systems:

- Rarely, if ever, would climatic conditions be the same over the entire area contained in the river basins which could cause run-off from all treated fields at the same time.
- 2. For many reasons including economics it is highly improbable that all of the cotton and/or soybean acreage with a given river drainage basin would be treated with diflubenzuron. Recent USDA projected use patterns for diflubenzuron use on cotton and soybeans indicate that actual cotton and soybean acreages treated will not exceed about 15%

- and 5%, respectively, of the treated acreages assumed in the model.
- 3. It is also unlikely, due to economics and other reasons, that the treated acreages would receive the maximum rate permitted by the label. Most likely, the acreages treated would be at lower rates and at different frequencies due to variation in pest populations, planting dates, plant growth rates and climatic conditions.
- 4. Seldom, and certainly not in all the areas concerned, would run-off from treated acreage move directly and immediately into a river system. Rather, the usual situation would involve delays in water movement caused by various natural geographical features (movement through vegetation, changes in soil permeability and type, and areas of variable elevation) and man-made features (ditches, canals and other drainage systems). These delays in diflubenzuron movement into the major streams would result in major reductions in diflubenzuron concentrations through adsorption to soils, settling, and chemical breakdown.

Consideration of these assumptions in the USEPA model is most important in arriving at a reasonable estimate of what might occur as a result of contaminated water run-off. It must be emphasized that the available experimental data on the run-off potential of diflubenzuron (both laboratory and field studies) suggest that this compound will be subject to, at most, very minimal run-off. Thus, there is currently no indication that the proposed uses of diflubenzuron will result in any residues being discharged into estuarine or salt water environments, and the possibility that diflubenzuron may interact with any organisms in such environments must at this point be considered problematical.

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off. Thus, there is currently no indicester that the proposite ex-

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Finally, consideration must be given to the comparison of diflubenzuron with other chemicals that are used as alternatives. In most cases, the effects of diflubenzuron on non-target organisms are considerably less than those of alternative compounds due to diflubenzuron's characteristics of lower rates of application required to control target species, short residual life, less effects on non-target organisms, and less hazard to human applicators.

The chemicals that encurry as elternatively. In most cases, the encurry then chemicals that encurry as elternatively. In most cases, the encurry then are considerably less than note of the compounds due to diffusencury's characteristics of lower retriction required to control target species, and treatment organisms, and less hazard to not not target out organisms, and less hazard to not not target out.

HUMAN EXPOSURE: DIETARY

Human dietary exposure projections were made based on three possible sources of dietary intake of diflubenzuron residues: direct consumption of cotton or soybean seed and their processed fractions, consumption of meat, milk, and eggs from livestock and poultry fed cottonseed and/or soybean seed fractions from treated crops, and consumption of fish from diflubenzuron-contaminated waters. Cottonseed and soybean seed can be considered to be the only significant sources of dietary exposure of livestock to diflubenzuron residues, because label restrictions prevent grazing treated fields or pastures, or feeding treated cotton or soybean foliage. As will be discussed below, current projected uses of diflubenzuron in mosquito control and for the control of certain forest insects are not likely to result in any significant human dietary exposure.

In developing the exposure profiles, a "worst case" situation was assumed in which cottonseed and soybean residues were projected to approach levels as high as the minimum sensitivity of the analytical enforcement method (0.05 ppm). This approach assumes residues in treated crops at levels clearly higher than those likely to be seen under normal insect control practices, because numerous residue studies in cottonseed and soybeans have shown that "real world" residues are almost always <0.05 ppm in the whole or processed seed. In making the projections under the "worst case" scenario, it was also assumed that all cottonseed and soybean food or feed products were derived from diflubenzuron-treated crops, whereas in reality, <15% and <5% each of the total cotton and soybean acreages, respectively, are likely to receive any diflubenzuron treatments at all under the proposed cotton and soybean registrations.

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## COTTON AND SOYBEANS

<u>Direct Human Exposure</u>. The human population can be expected to receive direct dietary exposure to diffubenzuron residues through consumption of cotton-seed and soybeans and their processed fractions. However, a review of residue data revealed that residues in whole or processed cottonseed and soybeans will, in all cases be <0.05 ppm. Direct utilization of cottonseed and soybean products as human food sources comprise at present only a minor proportion of the human diet and thus direct dietary exposure of humans <u>via</u> these sources is projected to be very minimal. Food factor tables from Lehman (1962) indicate that the typical human diet contains about 0.15% and 0.92% of cottonseed and soybean fractions, respectively. Thus, the "worst case" intake of diffubenzuron residues from direct consumption of cottonseed and soybean fractions can be calculated to be 0.00000188 mg/kg/day (cottonseed) and 0.00001150 mg/kg/day (soybeans) (Table 16).

The consumption of infant formulas represents a situation in which dietary exposure to diflubenzuron residues of a specific portion of the human population may occur. Certain infant formulas contain soybean oil and/or soy protein, but it is not believed that cottonseed fractions are used in infant formulas to any significant extent, if at all. Based on published information (Barness et al., 1976), it was assumed for the current assessment that such formulas might contain a maximum of 5% total soybean fractions (oil and protein). Thus, a 7 kg infant, consuming 0.68 kg (1.5 lbs) of formula/day, could conceivably consume as much as 0.034 kg total soy fractions (0.68 x 0.05). If the soy fractions contained 0.05 ppm diflubenzuron, the total diflubenzuron intake would be 0.0017 mg diflubenzuron/ 7 kg infant/day (0.034 x 0.05) or 0.00024 mg/kg/day.

Food Chain Exposure. Whole cottonseed and soybeans and their various fractions are commonly used as components of livestock and poultry feeds, and

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consumption of infant funcular represents a situation on the digitary diffusery we residues of a specific vertice of the moves popularies cartain soybean of and/or say process, who allowed that cottonseed fractions are used in intent formulas to any estent, if at all. Eased or oublished information (Burbess et and assumed for the current assessment that such formulas tiph?

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"Worst case" projections of human dietary intake of diflubenzuron residues from food sources that may potentially contain diflubenzuron residues as a result of its use as an insecticide on cotton, soybeans, forests, and for mosquito control. Table 16.

Maximum difl. intake (mg dif/kg body weight/day)	0.00000188 0.000001150 0.00000003	0.00000006 0.00001350 0.00000074 0.00000059
/ Maximum difl. intake (mg dif/ 50 kg person/day)	0.00011250 0.00069000 0.00000162	0.00000340 0.00081000 0.00004410 0.00004155 0.00170317
Specific commodity Maximum diflintake (kg fopd/ intake (mg dif/ 60 kg person/day)	0.00225 0.0138 0.16215	0.4293 0.0162 0.0441 0.04155
Projected maximum residue present (mg/kg)	0.05 0.05 0.00001	0.000008 0.05 0.001 0.001
% of Diet	0.15	28.62 1.08 2.94 2.77
Human Food Source	Cottonseed Soybeans Meats, red	Milk and dairy products Fish and shellfish Poultry Eggs

cpossible average "worst case" residue for edible tissues of red meat producing animals (see Table 20).

See Table 20. **Based on 50x magnification of residues from water containing 0.001 ppm diflubenzuron (see text). **Possible average.**

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Assuming a "worst case" situation where diflubenzuron residues in these two commodities reached 0.05 ppm, estimation can be made of the maximum dietary exposure of various food producing animals to diflubenzuron residues from consumption of seed or seed products. These estimates are given in Table 17.

The estimates in Table 17 indicate that broiler chickens and turkeys have potential for exposure to higher levels of diflubenzuron residues than other food animals, due to a combination of high feed intake during their active growth stage and relatively high levels of cottonseed and/or soybean fractions in their diets. The calculations indicate that exposure of red meat and milk producing animals, and laying hens, to diflubenzuron residues through these feed sources will be quite low (Table 17).

Residue Projections: Cattle. On the basis of residue and metabolism studies with diflubenzuron in cattle, and on maximum projected dietary exposure to diflubenzuron residues through consumption of contaminated cottonseed and soybeans, "worst case" estimates of residues expected in meat and milk resulting from the cotton and soybean registrations were made. Long-term feeding studies with diflubenzuron in lactating cattle have been conducted by Miller et al. (1976) and Smith and Merricks (1976) in which experimental conditions allowed plateau levels of residues in milk and tissues to be reached. In each case, secretion of residues into milk and their retention by edible tissues was very low. Appropriate findings from these studies are summarized in Table 18.

Based on "worst case" exposure of cattle to diflubenzuron residues <u>via</u> cottonseed or soybeans (Table 17) and the residue patterns observed in the "reference" studies by Miller et al. (1976) and Smith and Merricks (1976) in cattle feeding studies with diflubenzuron (Table 18), the maximum projected

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Table 17. Estimates of maximum dietary exposure of livestock and poultry to diflubenzuron residues from consumption of cottonseed and soybean fractions.

		imum eed				imum enzuron	Feed Consumptio	Maximu n Diflube	~
	Res	idues	See	ed in	Residu	es, ppm	% Body	Body We	eight
	рр	m	Diet	, %	Total	Diet _	wt/day	mg/kg/	day
Animal	<u> </u>	<u>. S</u>	C	<u>S</u>	<u> </u>	S		C	S
Cattle, beef	0.05	0.05	15	15	800.0	0.008	1.5	0.00012	0.00012
Cattle, dairy	0.05	0.05	15	25	0.008	0.012	1.5	0.00012	0.00018
Hogs	0.05	0.05	5	20	0.0025	0.010	4.0	0.0001	0.0004
Horses	.0.05	0.05	15	20	0.008	0.010	2.0	0.00016	0.0002
Lambs	0.05	0.05	20	15	0.01	0.008	4.0	0.0004	0.00032
Chicken,									
broilers	0.05	0.05	10	25	0.005	0.012	12.0	0.0006	0.00144
Chicken,							•		
laying hens	0.05	0.05	3	35	0.0015	0.018	6.0	0.00009	0.0011
Turkeys	0.05	0.05	10	25	0.005	0.012	12.0	0.0006	0.00144

aLower limit of sensitivity of analytical enforcement method for diflubenzuron. DEstimate from Harris, 1975. CEstimate from Lehman, 1965. Estimate from Clark et al., 1978.

Estimates of the mem distany expession of Afrestack and poultry to on residues from consumption of cottonssed and soybean fractions.

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Table 18. Summary of long-term feeding studies with diflubenzuron in cattle.

anon-radioactive study. ^bRadioactive study. ^CEquivalent to 5.0 ppm dietary feeding level. ^dResidues not detected.

residues in milk and edible tissue were calculated by the following proportional scheme:

Reference study treatment level, mg/kg/day as 0bserved tissue residue, ppm

Maximum anticipated diflubenzuron exposure, mg/kg/day, Table 18

(projected tissue residue, ppm)

These calculations of necessity assume that pharmacodynamics of the crop residues in animals (whether unmetabolized diflubenzuron, its metabolites, or a mixture thereof) approximate that of the parent compound administered directly. They are also based on an assumed direct dose-response relationship as regards residues in tissue and milk. The results of these projections for cattle tissues and milk are shown in Table 19 for both cottonseed and soybean residue sources.

As the data in Table 19 indicate, even under "worst case" exposure of cattle to cottonseed or soybeans from treated crops, levels to be expected in milk and edible tissues are exceedingly low, almost always in the sub-part per billion range. Comparisons of the projected residues calculated using either of the two "reference" studies reveal only two noticeable inconsistencies, namely the levels of residues projected in milk and liver (Table 19). Milk residue projections based on the Smith and Merricks study are about 50-fold higher than those based on studies by Miller and co-workers, while liver residue projections from the Smith and Merricks data are fully 3 orders of magnitude greater than liver residues calculated using the Miller et al. study as a model. It seems almost certain that these differences can be partially if not wholly explained by the fact that the Smith and Merricks study utilized radioisotope labeled diflubenzuron, which allowed quantitation of both diflubenzuron and its

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cultifient of necessity assume that pharmacodynamics in the state of the enimals (whether unmetabolized diffubenzuron, its sateloffies, whereof) approximate that In the parent compose addinistered direct here also based on an assumed direct dose-respons relationship as regard in tissue and milk. The results of those projections for call and milk are shown in Table 19 for both cottonseed and soybook rest

s undata in Table 10 indicate, ever under "words coop" exposion of the cottonseed or soybeans from trocked crops, levels to be expected used edible tissues are exceedingly low, almost always in the sub-park per fange Comparisons of the projected residuer calculated used either editors reveal only two meticeable inconsistantics, remain of residues projected in malk and liver (Table 18). Will pestage sed on the Smith and Merricks study are about bu-fold higher than add on the Smith and do-worders, while liver residue projections that let are fully 3 orders of magnitude greater than the liter at all study as a model. It serves the liter at all study as a model of excitation can be partially and wholly excitated.

Table 19. Maximum diflubenzuron residues projected in milk and edible tissues of cattle fed cottonseed or soybeans from treated crops.

	Maximum calculated	residue, ppm, based on	
	indicated reference study		
Cattle Tissue	Miller et al. (1976)	Smith and Merricks, (1976)	
Cottonseed Exposure			
Milk	0.0000002	0.000003	
Muscle	0.00000075	<b>0.0</b> 00006 ^a	
Liver	0.0000075	0.00036	
Kidney	0.00000075	<b>0.0</b> 00005 ^a	
Fat	0.0000015	<b>0.0</b> 00006 ^a	
Soybean Exposure			
Milk	0.0000002	0.00001	
Muscle	0.000001 ^a	0.0001	
Liver	0.000001	0.001	
Kidney	<b>0.0</b> 00001 ^a	0.0001 ^a	
Fat	0.000002	0.0001 ^a	

aLower limit of projected residue, due to sensitivity of the analytical method used.

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metabolites, while the Miller study employed unlabeled diflubenzuron and thus only the unmetabolized parent compound was detected. It is known that diflubenzuron metabolites comprise a considerable proportion of the total residue in milk (Ivie, 1978a; Smith and Merricks, 1976), and that the great majority of diflubenzuron residues in animal liver are primarily metabolic products and not intact diflubenzuron (Ivie, 1978b).

Poultry. Sufficient residue and metabolic fate data on diflubenzuron in poultry are available to permit projections of "worst case" tissue and egg residues to be anticipated after consumption of feeds containing cottonseed or soybean fractions. The calculations were made in the same manner as for cattle above, using data in Table 17 for estimates of maximum levels of cottonseed and soybean products in poultry feed. Estimates of maximum exposure of birds receiving diflubenzuron residues via dietary sources were made (Table 17), then the maximum tissue and egg residue profiles were developed on the basis of the two long term feeding studies with diflubenzuron in poultry that are summarized in Table 20. Based on the data in Table 20, projected residues in meat and edible tissue of poultry fed diets containing cottonseed or soybeans from treated crops were made. These projections are shown in Table 21.

Examination of the data in Table 21 indicates that, as with cattle, projected residues in poultry and eggs after consumption of diets containing cottonseed or soybean fractions were quite low. In all cases, projected residues were in the low or sub-ppb range. It does appear that, based on maximum utilization of cottonseed and soybeans in poultry feed (Table 17), growing chickens and turkeys fed cottonseed fractions in their diets are likely to exhibit tissue residues up to an order of magnitude greater then laying hens. This is because of considerably greater feed consumption on the part of broiler chickens and growing turkeys as compared to laying birds, and the fact that

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Table 20. Summary of long-term feeding studies with diflubenzuron in laying hens.

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	Dose Level	puration					
7	ma/ka/dav	weeks	Eggs	Muscle	Liver	Kidney	Fat
Miller et al., (1975)	0.10	ω	0.05	ı	ı	ı	1
	.003	4	0.003	.001	.003	.003	.003

^aNon-radioactive study. ^bRadioactive study. ^cEquivalent to 1.6 ppm dietary feeding level. ^dEquivalent to 0.05 ppm dietary feeding level.

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Table 21. Maximum diflubenzuron residues projected in milk and edible tissues of poultry fed cottonseed or soybeans from treated crops.

	Max	timum calculated	Maximum calculated residue, ppm, based on	no
		indicated	indicated reference study	
	Miller et al. (1975)	(1975)	Smith (1976)	(9)
Poultry tissue	broilers/turkeys	laying hens	broilers/turkeys	laying hens
Cottonseed Exposure				
Eggs	1	0.000045	1	60000.0
Muscle	1	ı	0.00026	0.00003
Liver	1	1	9000*0	60000*0
Kidney	1	,	900000	6000000
Fat	1	1	9000*0	6000000
Soybean Exposure				
Eggs	å	0.00055	1	0.0011
Muscle	ı	1	0.00048	0.00036
Liver	ı	1	0.0014	0.0011
Kidney	ı	i	0.0014	0.0011
Fat	· · · §		0.0014	0.0011

^aTissue residues not determined in studies of Miller et al. (1975).

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cottonseed fractions may comprise a considerably greater proportion of the total diet of growing versus laying birds (Table 17). Projected maximum poultry tissue residues in broiler and laying birds fed soybean-containing diets are much more comparable because of the relative proportions of soybeans likely to be included in broiler versus laying feed (Table 17).

Other Food Animals. The preceeding projections of maximum exposure and residue profiles expected in cattle and poultry as a result of the cotton and soybean registrations are useful in projecting anticipated residues in other food animals whose diets contain cottonseed or soybean fractions (Table 17). The actual projections for these animals, including swine, sheep, horses, and others, were not made because appropriate residue and/or metabolism data were limited or unavailable. However, there is no reason to believe that residue profiles for other red meat and milk producing animals, and other poultry, will differ appreciably from the profiles generated in Tables 19 and 21. Although residue profiles in ruminants are often not considered to be representative of other red meat producing animals due to the somewhat unique metabolic capabilities of the rumen itself, in the case of diflubenzuron, the rumen cannot be considered a complicating factor. Metabolism studies by Ivie (1978a) have conclusively shown that diflubenzuron is metabolically stable within the alimentary tract of ruminants.

Because fish comprise a significant portion of the human diet, they must be considered as a potential dietary source of diflubenzuron residues. However, based on the projected use patterns for diflubenzuron, it would appear that the potential for fish accumulating significant residues of the compound are quite low. It seems possible that, through run-off, drift or a combination thereof, water concentrations of diflubenzuron as high as 0.001 ppm might, on occasion,

er Ford Animals. The preceeding projections of maximum expasion of profiles Expected in cattle and poultry a a result with talled an registrations are useful in projecting enticipated residum. The projecting enticipated residum.

ual projections for these animals, including swine, shown horses, and were not made because appropriate residua and/or motabol in Jala smin or imavalishle. However, there is no reason to believe that residual for other red meat and milk producing animals, and other poultry, a paciably from the professorated in lables is annial. Stores or office in numinants are often not considered in be represented by discounting animals due to the scenewhat indust metabolishing of the rumen itself, in the case of diffubenzunce, as as early the rumen itself, in the case of diffubenzunce, as as early the rumen itself, in the case of diffubenzunce, as as early

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Exposure" section). If such were the case, residues in fish meat might reach levels approaching 0.05 ppm, assuming a biomagnification of 50x. The 50x level of potential biomagnification of diflubenzuron by fish seems an appropriate assumption on the basis of available information (Apperson et al., 1978; Booth et al., 1976; Schaefer et al., 1978). In projecting residues of diflubenzuron in fish, it is important to note that, although fish are capable of limited biomagnification of diflubenzuron from water, appreciable water contamination from the proposed diflubenzuron uses should be infrequent, the compound itself is not highly persistent in water (Schaefer and Dupras, 1976), and fish are capable of rapidly depleting residues of diflubenzuron from the body once exposure to the compound is terminated (Booth et al., 1976; Schaefer et al., 1978). Thus, the potential for significant human dietary exposure to diflubenzuron via residues in fish would appear to be very minimal.

## EXPOSURE FROM USES AGAINST MOSQUITOES

<u>Proposed Label</u>. The proposed label excludes application on crops or in areas used for food, feed, hay, pasture, or for potable water, livestock watering or for crop production. Inasmuch as these restrictions would eliminate over 95% of the habitats where mosquito abatement districts would utilize diflubenzuron, only a very small amount of this compound could be used. In addition, such use would be in locations where neither man nor animals utilized for food would be exposed, and thus hûman exposure <u>via</u> the dietary route as a result of diflubenzuron use in mosquito control would be essentially nil.

Expanded Label. Should an additional label be requested and approved for the use of diflubenzuron on lands used for grazing livestock or growing

Inoq ower a period of et lacet a sew raps (aug Mona) argot facilies action). If such were the cose, residues in fith mean count each each were the cose, residues in fith mean count each each of 0.00 per section of 50x. The 50a level eating biomagnification of 50x. The 50a level eating biomagnification of diffusionation (Apre con et al., 1973; Apreh 1975; Schaefer et al., 1973). In projecting residue or diffusionation if it is imposed to note that, although field an earlier or diffusionation of diffusionation from water, apprehend and contains a leation of diffusionation uses should be introduced, the compound itself is a repit'y depleting residues of diflusionation and bupies 975), and if a te the compound is terminated (Schaefer and Bupies 975), and if a te the compound is terminated (Substitut and al., 1916; Scha fer of also thus, the potential for significant much dictory exposure

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sees abol. The proposed label excludes analycerian on comparts for food, feed, hay, pasture, or for potable web. [15,000 of united constructions would aliented of the habitats where mosquito abatement districts would usified for only a very small amount of this consequational valid agreed. In set would be in locations where neither man on animals utilized out a exposed, and thus immen exposure via the dietary route as a functional management of the dietary route as a large management of the dietary route as a large management of the dietary route as a large management and approved for the mosquite control would be essentially miles and an additional label be eventually miles and an additional label be eventually miles.

feed, much larger acreages would be treated for mosquito larvae. If the 25 WP formulation of diflubenzuron were dispersed in aqueous spray, within the 0.025 to 0.04 lb AI/acre range, initial residues in 4-6" deep water would be 0.03 ppm or less and 4 ppm or less on vegetation (Schaefer and Dupras, 1976).

If cattle were held on treated fields and fed continuously on grass containing 4 ppm diflubenzuron, the residues for milk and tissues are projected in Table 22. From the projections in Table 22, it appears that in such an exposure situation, the liver of the grazing animals might well exhibit total residues in excess of the sensitivity level of the analytical enforcement method.

Cattle are not normally held on flooded pastures, but if they were exposed continuously to water supplies in treated fields, and this water contained the highest expected diflubenzuron residues (0.03 ppm, Schaefer and Dupras, 1976), residues projected in milk and tissues would be at least an order of magnitude less than those indicated in Table 22, since maximum daily intake from water would not exceed 0.003 mg/kg/day.

The problems of livestock exposure to residues on vegetation following application of aqueous sprays of diflubenzuron can be essentially eliminated by using granular formulations. It is anticipated that diflubenzuron residues in water would not vary appreciably between the WP and granular formulations (Schaefer and Dupras, 1977), thus, granular applications offer a means of achieving mosquito control and simultaneously minimizing exposure of grazing stock to diflubenzuron residues.

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Table 22. Maximum diflubenzuron residues projected in milk and edible tissues of cattle fed pasture grass containing 4 ppm diflubenzuron.

		Maximum calculated residue, ppm, based on indicated reference study		
Cattle Tissue	Miller et al. (1976)	Smith and Merricks, (1976)		
Milk	0.00008	0.004		
Muscle	0.0004 ^a	0.032 ^a		
Liver	0.0004	0.43		
Kidney	<b>0.0</b> 004 ^a	0.032ª		
Fat	0.0007	0.032 ^a		

^aLower limit of projected residue due to sensitivity of the analytical method used.

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## EXPOSURE FROM USES AGAINST FOREST INSECTS

The use of diflubenzuron to control the gypsy moth in hardwood forests and the tussock moth in coniferous forests would appear to create little likelihood for significant human dietary exposure. Although consumption of fish and game taken from treated areas might result in some intake of diflubenzuron, this would probably be infrequent and the exposure would likely be at extremely low levels. Wild fruits, nuts, berries, etc. might also be a medium through which very low levels of diflubenzuron would enter the human food chain as a result of diflubenzuron's use in forest insect control.

#### PROJECTION OF TOTAL HUMAN DIETARY EXPOSURE

estimates of daily human dietary intake of diflubenzuron residues. These projections (Table 16) are shown both as mg diflubenzuron/day for a 60 kg person, and as mg/kg/day. As the table indicates, these "worst case" estimates project that human dietary exposure to diflubenzuron from all food sources will be at an extremely low level, not exceeding 0.00002840 mg diflubenzuron/kg body weight/day. The projections obtained in these calculations are almost certainly much higher than those likely to be encountered in a real-world situation.

Based on the fact that diflubenzuron will be used on only relatively small portions of the cotton and soybean acreages, and that residues in the seeds of these crops may be considerably below the 0.05 ppm sensitivity limit of the analytical enforcement method, it seems likely that average human dietary exposure will be much less, perhaps 1/10 - 1/100, of the "worst case" projections presented here.

#### SLOBAR ISSOUR LEADER SEEM MEET

e use of disturbensured to control the appear to create little sidesifies a sork meth in conflowing forests would appear to create little sidesifies a ficant human distary exposure. Although consumption of fix and greater treated areas ght result in some intake of diffuliantment, robably II infrequent and the exposure would likely be at extraoris low. Wild fruits note, berries, etc. might also be a medium through whis els of diffubenzaron would enter the human food chain as a result of exposure used to the control.

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HUMAN EXPOSURE: APPLICATORS, FIELD WORKERS, BYSTANDERS

COTTON

Formulation and Use Patterns. A wettable powder formulation of diflubenzuron (Dimilin W-25) containing 25% active ingredient will be used in cotton applications. The diflubenzuron in the WP formulation has a particle size distribution ranging from 2-5 $_{\mu}$  and the formulation is packaged in 5 pound bags and 25 pound fiber drums.

Diflubenzuron will be applied to cotton at 0.0625 or 0.125 lb AI/acre as an aqueous spray for control of the boll weevil. A maximum of 0.75 lb AI/acre/season is permitted, thus limiting the number of applications. About 90% of the diflubenzuron used on cotton will be applied by fixed-wing aircraft and the remainder by tractor-drawn boom sprayer. One-fourth to one-half pound of the Dimilin W-25 is mixed with 2-4 quarts of emulsifiable paraffinic crop oil and then with at least 2 parts additional water for each part of oil. Aerial application is made using a total volume of 1-3 gallons/acre and ground applications involve 5-30 gallons/acre. Detailed parameters for fixed-wing aircraft application of diflubenzuron to cotton are indicated in Table 23.

Under the current EUP approved for cotton by the USEPA, a total of 2,590 acres are allowed to receive diflubenzuron treatment. If a single aerial applicator treated all permitted acres, the swath exposure time per application would be 5 hours. Assuming 6 applications per season at 7-day intervals, the in-swath exposure time would be about 30 hours. If it were assumed that there would be one applicator per state where the EUP is permitted, this would represent 12 applicators with an average in-swath exposure of about 25 hours per applicator per season.

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Table 23. Parameters for fixed-wing aircraft application of diflubenzuron to cotton.

Formulation	W25 wettable powder
Equipment	Fixed-wing aircraft
Representative nozzle	Teejet 8006, fan spray
Flying speed	120 mph
Boom pressure	20 psi
Altitude	5-10 feet
Application rate	1-2 ounces AI/acre
Volume of application	1-3 gallons
Frequency of application	7-day interval
Number of applications/season	6
Hours spent in flying/day	4-5
Hours spent in spray swath/day	1
Average length of spray swath	1/2 mile
Average width of spray swath	40 feet
Average acres treated per day	500
Average acres treated/week	2,500
Average acres treated/season/pilot	21,000
Protective clothing	Coveralls and gloves
Number of pilots involved in EUP	12
Number of mixer/loaders	12
Number of pilots involved in full use program	66
Number of mixer/loaders involved in full use program	66
Number of applicators involved in ground applications (10% of acreage)	1185
Number of mixer/loaders involved in ground application (10% of acreage)	0

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Regarding the full label registration on cotton, the percent of acres treated aerially will not change. The exposure study group for diflubenzuron has projected the potential treated acres in the United States for boll weevil to be 1,540,000. Assuming an average of 6 applications per season, this represents 9,240,000 acre treatments per season. If the average flying time per day is considered to be 5 hours, the actual in-swath time will average about 1 hour. Thus, each aerial applicator will spray about 500 acres/day or 3,500 acres on a 7-day repeat spray schedule. Calculating acre treatments per season, this would total 21,000 acres per applicator (3500 x 6). If it is assumed that 1,540,000 acres receive the 6 applications, 440 applicators will be required  $(9,240,000 \div 21,000)$ .

Assuming that conditions outlined in Table 24 are representative, a protocol for the measurement of dermal and inhalation exposure of the mixer/loader can be developed. Assuming a volume/acre of 1 gallon of diflubenzuron solution and the applicator treats 500 acres/day, the 500 gallon mixing unit would meet the needs for a full day's operation. Mixing this volume of spray solution daily would eliminate the concern of leaving excess in the mix unit overnight, when the wettable powder would separate and require additional agitation time the following morning to be confident of a uniform mix.

Under the above operating conditions, the mixer/loader would add 125 pounds of Dimilin W-25 to the mixing tank in the process of filling it with the carrier (water). The total exposure time for weighing, mixing, and loading would not exceed 40 minutes.

Assumptions. The following assumptions were made to permit calculation of diflubenzuron exposure resulting from its application to cotton.

ing the hill label registral loss on cation, the parcent of ucrus will will not change. The exposure study group for diffuseration acted one potential treated sures in the United States for boll wearflested one potential treated sures in the United States for boll wearflest, 2,000. Assuming an average of 5 applications per season, this is 1,240 000 acro featments per season. If the average flying hims per onsidered to be 5 hours, the actual in-swath time will everage use each certal applicator will spray about 500 rures/day or 3,500 use each certal applicator will spray about 500 rures/day or 3,500 of total 21,000 acres per applicator (3500 x 6). If it is assessed that cotal 21,000 acres per applications. And applicators will

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the measurement of dermal and inhalation exposure of 15 (x22)

can be developed. Assuming a volume/acre of 1 gallor of dispersions and the applicator treats 500 acres/day, the 500 gallor mility of the needs for a full day's operation. Mixing this volume of 3.4 failty would eliminate the concern of leaving excess in the mility would eliminate the concern of leaving excess in the mility when the wettable powder would separate and require additional time the following morning to be considered of a uniform mix.

Unce above operating conditions, the mixer/leader would add 12 10 or 32 with the corning which the process of filling it with the certification of the mixing tank in the process of filling it with the certification of the mixing tank in the process of filling it with the certification of the mixing tank in the process of filling it with the certification of the mixing tank in the process of filling it with the certification of the following mound of the certification of the mixing tank in the process of filling it with the certification of the certification of the mixing tank in the process of filling it with the certification of the certific

ons. The following assumptions were made to permit calculation of

Table 24. Mixer/loader information for aerial application of diflubenzuron to cotton.

Capacity of mixing or nurse tank	500 gallons
Volume of diflubenzuron solution	
applied/acre	1 gallon
Acres treated/day/applicator	500
Rate of diflubenzuron (AI/Acre)	0.0625 1b AI
Number of applications/season	6
Load capacity of plane spray tank .	150 gallons
Volume of transfer pump on mixing unit	15 gal/minute
Number of mixer/loaders required	440

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- A. Mixer/loaders will receive their primary exposure to diflubenzuron by contact with the dust. Respiratory exposure will be primarily during the actual bag opening/powder pouring operation. Estimated time of exposure per bag opening (5 lb bag) is 10 seconds. The amount of respirable Dimilin W-25 dust in the air is estimated to be 10 mg/m³ during this operation.
- B. Dermal exposure of mixer/loaders to Dimilin W-25 is also primarily associated with the short-term bag opening operation. However, the only experimental data available (Jegier, 1964) is for "tank-filling operation," which apportions the exposure over the entire mixing/loading time span.

  Jegier's estimate is 52.9 mg/hour for a 25% Guthion wettable powder.
- C. Tank filling requires 40 minutes per day to mix and transfer 4 batches of 150 gallons each when either aerial application or boom spray treatment is involved. Only one mixer/loader is assumed per treatment operation.
  - D. No flagmen will be utilized.
- E. No bystanders will be permitted to be directly exposed beneath the spray swath. Spray areas will be posted to assure adherence to this restriction.
- F. Post-treatment scouting and cultural activities in the field are not expected to result in substantial respiratory or dermal exposure.
- G. Exposure to jeep- or tractor-drawn boom applicator will be similar to that described by Wolfe et al. (1961) for tractor-drawn boom spraying of the herbicide DNOSBP. Wolfe found a mean dermal exposure of 22.4 mg/hour and a mean inhalation exposure of 0.12 mg/hour at an average treatment rate of 3 lbs/acre. In the above case, dermal exposure from the actual mixing/loading operation has been factored out and the 22.4 mg/hour represents the actual spraying operation.
- H. Dermal exposure to downwind spray drift has been estimated by Severn et al. (1978) from data originally developed by Yates et al. (1967). This data

should be applicable to aerial sprays of diflubenzuron provided a correction is made for the particle size distribution differential. While no direct estimate can be developed for drift of a 200 micron VMD spray (spray charactristics from Table 23), inspection of Table 4 from Yates et al. (1967) for 420 microns and 290 microns VMD sprays suggests that as a conservative estimate, the 200 VMD droplets would not lead to more than 2x the deposit calculated for a 420 micron VMD spray. Corrected value for the data of Severn et al. (1978) are shown in the next section under "Unit Exposure Calculations."

Respiratory exposure to such aerial drift will be negligible in comparison to the dermal and is not considered here.

I. The exposure of spray pilots to endrin during the application of 60 lb AI/100 gallons of finished spray to various vegetable crops has been measured by Jegier (1964a). Jegier found a potential inhalation exposure of 0.08 mg/hour and a potential dermal exposure of 1.18 mg/hour to pilots in an enclosed cockpit. The rate of application was 1 lb AI/acre. Assuming that exposure is directly proportional to treatment rate/unit area and that the aircraft used are similar, a correction factor

$$\frac{0.06}{1.0}$$
 =0.06

is used to calculate unit exposure from maximum use rate conditions.

<u>Unit exposure calculations</u>. Based on the use patterns and assumptions discussed above, the following Unit Exposure Calculations can be made:

# A. Mixer/Loader

- Dermal Exposure (see assumptions B, C)
  - a. Aerial Applicators

 $52.9 \text{ mg/hour } \times 4/6 \text{ hour/day} = 35 \text{ mg/day}$ 

Placeb's to mericle size distribution differential. While no inect estimated for drift of a 200 micron with apray (apray charactristics from mane than of Table 4 from Vates et al. (1957) for ADU microns and a VMb aprays suggests that as a conservative estimate to 200 value than 2x the deposit calculated for a GDU micron.

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- B. Tractor Boom Spray Applicators
  52.9 mg/hour x 6 hours/day = 317 mg/day
- B. Tractor-drawn boom applicator (see assumption G)
  - 1. Dermal Exposure

    22.4 mg/hour x 6 hours/day x  $\frac{0.125}{3}$  = 5.6 mg/day
  - 2. Resiratory Exposure

    0.12 mg/hour x 6 hours/day x  $\frac{0.125}{3}$  = 0.03 mg/day

Note: This same person will also do mixing and loading.

- C. Pilot Exposure (see assumption I and Table 23).
  - 1. Dermal Exposure

    1.18 mg/hour x 1 hour/day x 0.06 = 0.08 mg/day
  - 2. Respiratory Exposure
     0.08 mg/hour x 1 hour/day x 0.06 = 0.005 mg/day
- D. Residents Living Immediately Adjacent to Spray Areas (see assumption H).

Table 25 provides an estimate of dermal exposure that might be expected of persons standing outdoors during the actual spray operation. Since the great preponderance of dermal exposure is due to large droplets (mass varies by the cube of the droplet radius) and since residents remaining indoors at the time of spraying will be protected from all but the finest droplets, dermal exposure to such individuals will be negligible.

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to dermal exposure that might US carected of section section. Since the Great contact to law draphets (mass varies by the general endoors at the time a dets, dermal expedient to

Table 25. Potential diflubenzuron deposition on human skin downwind from target area after aerial application to cotton.

Downwind Distance	Potential Dermal Deposition
(meters)	from Spraying (micrograms)a,b
25	640
45	330
96	150
196	70
<b>3</b> 98	35

^aAssumes 0.3 m² of exposed skin surface. ^bData of Severn et al. (1978) corrected for concentration  $(\frac{0.125}{0.25} = 0.5)$ 

and particle size (2X) to give an effective correction factor of 1X.

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and particle size (24) to give an offe

Considering the areas for potential diflubenzuron treatment, the assumption is made that the average size cotton farm is 112 acres (total cotton acreage number of farms). For the diflubenzuron-treated acres (1,540,000 projected), this would mean 13,750 farms involved. Assuming an average family of 4 per farm and one additional family of 4 on each 100 acres, the total potential population involved would be 110,000 people. It is not likely that this number of people would be outside during spraying. The assumption is that 1 out of 4 could be outside, which makes the potential number exposed to be 27,500.

#### SOYBEANS

Formulation and Use Patterns. The wettable powder formulation of diflubenzuron to be used on soybeans is the same as that previously described for cotton. Application to soybeans will be at the rate of 0.0312 - 0.0625 lb AI/acre. One repeat application is permitted if damaging numbers of target insect larvae reappear. About 90% of the soybean applications will be made by fixed-wing aircraft and the remainder by tractor-drawn boom sprayer. Aerial application requires sufficient water added to the formulation to provide 1-3 gallons/acre coverage. Ground application will be made at a rate of 35 gallons finished spray/acre. Detailed parameters for fixed-wing aircraft application of diflubenzuron to soybeans are indicated in Table 26.

The three pests of soybeans that are effectively controlled by diflubenzuron are the velvetbean caterpillar, green clover worm, and the Mexican bean beetle. The soybean committee of the Diflubenzuron Assessmment Group has projected the areas of infestation for each of these pests and the acres currently impacted at three infestation levels. Assuming the current worst case, the potential acreage that might be treated would be 1,250,000.

ng the areas for potential diffusemental travers, the assumption to average site cotton form is 11% acres (total cotton screen).

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lu mean 13,750 . favolved. Assuming an arreage is additional family of 4 on each 160 acres, the total motential sapulation would be 110,000 people. It is not likely that this number ou stud during an assumption is that 1 and o' could be which mokes the notwerfall number exposed C1 be 21,500

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Table 26. Parameters for fixed-wing aircraft application of diflubenzuron to soybeans.

Formulation	W25 wettable powder.
Equipment	Fixed-wing aircraft
Representative nozzle	Teejet 8006, fan spray
Flying speed	120 mph
Boom pressure	20 psi
Altitude	5-10 feet
Application rate	0.0625 1b AI/acre (maximum)
Volume of application	1 gallon
Frequency of application	1.1 (average - 10% may receive 2 applications
Droplet size	200 microns VMD
Hours spent flying/day	5
Hours spent in spray swath/day	1
Average length of spray swath	1/2 mile
Average width of spray swath	40 feet
Average acres treated/day	500
Average acres treated/week/applicator	2,500
Average acres treated/season/applicator	21,000
Protective equipment (pilot)	Coveralls

The three soybean pests are regionalized with very minimal overlap between regions. Also, the velvetbean caterpillar is a late season pest (August-October), while the Mexican bean beetle apparently infests early planted soybeans first and then moves to other fields later in the season. Green clover worms, in general, infest soybeans earlier than do the other two pests but, with the exception of the midwest, do not pose an economic threat.

If one assumes that an applicator will treat an average of 500 acres per day, the in-swath potential exposure time will be 10⁺ minutes per 100 acres or 60 minutes per day. Also, assuming the worst case potential exposure, the 1,250,000 infested acres will be treated with diflubenzuron. Assuming 500 acres treated per day, operating 5 days per week for a period of 4 months (June, July, August, and September) and moving from region to region for the three pests, the acres treated per applicator could reach 40,000. This would calculate to an in-swath exposure time totaling 80 hours. It is not likely that one pilot would cover this acreage as there is a tendency to be regionalized with a base of operation. However, it does reflect the worst case exposure situation. Calculating potential exposure based on infested acres within a state is believed to more nearly reflect applicator practice.

The period and frequency of exposure for the mixer/loader will be the same as for cotton for any given time period, since the same individuals (applicator and mixer/loader) will be treating soybeans and cotton where these crops are growing in the same area.

Assuming conditions outlined in Table 27 to be representative of soybean applications, the measurement of dermal and inhalation exposure of the mixer/loader can be developed.

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Table 27. Mixer/loader information for aerial application of diflubenzuron to soybeans.

Capacity of mixing or nurse tank	500 gallons
Volume of diflubenzuron solution	
applied/Acre	1 gallon
Rate of diflubenzuron (AI/Acre)	<b>0.</b> 0625 1b
Number of applications per season	1
Total exposure time for mixing and	
loading/day .	40 minutes
Acres treated/day/applicator	500
Load capacity of plane spray tank	150
Volume of transfer pump on mixing unit	15 gal/minute
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Table 27. Mixer/looder information for ser. explication of

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Assuming a volume per acre of 1 gallon of diflubenzuron solution and the applicator treats 500 acres per day, the 500 gallon mixing unit would meet the needs for a full day's operation. Mixing this volume of spray solution daily would eliminate the concern of leaving excess in the mix unit over-night, when the wettable powder would separate and require additional agitation time the following morning to be confident of a uniform mix.

Assumptions. The assumptions made to permit calculations of diflubenzuron exposure resulting from its application to soybeans are identical to those made under A-I for the cotton analysis.

<u>Unit Exposure Calculations</u>. Based on the use patterns and assumptions previously discussed, the following unit exposure calculations can be made:

- A. Mixer/Loader
  - 1. Dermal Exposure (see assumptions B, C)
    - a. Aerial applicators52.9 mg/hour x 0.5 hours/day 26.5 mg/day
    - b. Tractor boom spray applicators
      52.9 mg/hour x 6 hours/day = 317 mg/day
  - 2. Respiratory Exposure (see assumption A)
    10 mg/m³ x 1.8 m³/hour (normal breathing rate for light work) x 0.0028 hours/bag opening x 0.25 (concentration factor)
    = 0.013 mg diflubenzuron/5 lb bag opening
- B. Tractor-Drawn Boom Applicators (see assumption G)
  - 1. Dermal Exposure

    22.4 mg/hour x 6 hours/day x  $\frac{0.06}{3}$  =2.7 mg/day

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inspiratory Exposure (see Resumplied 1)

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10 mg/m² : 0.0 a hours/had opening v 0.25 (concerns: an 100007)

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1.0 3 mg dr ubenziron; 15 brg opening

1.0 3 mg dr ubenziron; 15 brg opening

2. Respiratory Exposure

0.12 mg/hour x 6 hours/day x 
$$\frac{0.06}{3}$$
 =0.015 mg/day

NOTE: This same person will also do mixing and loading.

- C. Pilot Exposure (see assumption I and Table 26)
  - 1. Dermal Exposure
    - 1.18 mg/hour x 1 hour/day x 0.06 = 0.07 mg/day
  - 2. Respiratory Exposure
    - $0.08 \text{ mg/hour} \times 1 \text{ hour/day} \times 0.06 = 0.005 \text{ mg/day}$
- D. Residents Living Immediatlely Adjacent to Spray Areas (see assumption H).

Table 28 provides an estimate of dermal exposure that might be expected of persons standing outdoors during the actual spray operation. As with potential exposure from the cotton applications, persons indoors will not receive significant exposure from diflubenzuron application to soybeans.

Considering the areas for potential diflubenzuron treatment on soybeans, the assumption is made that the average size soybean farm is 102 acres (soybean acreage ÷ number of farms). For the diflubenzuron treated acres (1,250,000 projected), this would mean 12,255 farms involved. Assuming an average family of 4 persons per farm and one additional family on each 100 acres, the total population involved would be about 100,000. It is not likely that this number of people would be outside during spraying. The assumption is that 1 out of 4 could be outside which makes the potential number exposed to be about 25,000.

## MOSQUITOES

Formulations and Use Patterns. The wettable powder formulation of diflubenzuron to be used in mosquito control is the same as that previously

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Fro the cotton applications, persons indoors will missive each exposure from diffibenceron application to saybean steering the areas for potential diffusionary heastern is any expension to a saybean ampriton is made that the average size saybean fairs is 10% acrost teached acrost transport of farms). For the diffusionary treated across () — find his would mean 12,0% farms involved. Assuming an average Postitions per farm and one additional family on each 100 acrost, and the color of across a fact to stand would be about 100,000. Its not likely that I out of a standard which makes the putential number exposed to to about 05,0%).

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Table 28. Potential diflubenzuron deposition downward from target area after aerial application to soybeans.

Downwind Distance (meters)	Potential Dermal Deposition from Spraying (micrograms) ^a , ^b
25	320
45	165
96	75
196	35
398	18

^aAssume 0.3 m² of exposed skin surface. ^bData of Severn et al. (1978) corrected for concentration  $\frac{0.06}{0.25} = 0.25$  and for particle size

⁽²x) to give an effective correction factor of 0.5x.

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one 0.3 of ef exposed sain surface. Busin of Revern en a source cred for concentration 0.25 and for concentration 0.25

give an effective correction factor of 3.8x.

described. When mosquito abatement district equipment requires granules for aerial application, a 0.25% active ingredient granule may be made by mixing 30 lbs Dimilin W-25, 2957 pounds of coarse sand (20/30 mesh), 10 pounds of larvicide oil, and 3 pounds of Hysil followed by mixing for 30 minutes.

Diflubenzuron will be applied to intermittent fresh waters for mosquito control at a rate of 0.025 - 0.04 lb A1/acre of water. For aerial application, the granular formulation described above is used at a rate of 10-16 pounds of finished formulation/acre. About 75% of the total acrage to be treated will require the granular formulation. The remaining 25% of the total acreage will be treated about equally with tractor- or jeep-mounted boom sprayers at 25 gallons/acre, and with knapsack back sprayers at 25-100 gallons/acre. The proposed mosquito label permits the use of 5-100 gallons of finished spray/acre, depending on the equipment used. The parameters indicated in Tables 29-31 are considered representative for the proposed mosquito uses.

The extent of exposure to workers preparing the granular material will depend on the quantity needed per day and the kind of mixing equipment available. Assuming the applicator will cover the same acreage with granular as with liquid spray equipment, the quantity of granules needed for a day's operation would be a maximum of 9,000 pounds (500 acres x 16 lbs/acre). Under these conditions and assuming equipment that would mix 3,000 pounds per batch, 3 mixings per day would be required. The proposed label text indicates the time required for the preparation of 3,000 pounds to be 65 minutes. Thus, the exposure time to the formulators in preparation would be 3 1/4 hours per day, which includes loading the ingredients, mixing and unloading. The average number of workers involved in formulating is estimated at 3.

Assuming the load capacity of the plane to be 1,200 pounds, which would equal that for liquid (150 gallons  $\times$  8 lbs/gallon), the loader would be

suid be a marimum of 9,000 pounds (500 actrs x 10a/x/2). "
Itions and assuming equipment that remains 1,050 are x 15. 4.

* would be required. The proposed

for the preparation of 3,000 pounts to 30 is about us. a Thus he need to the formulators to preparation while but 1 1/4 hours to the formulators to preparation with the 1 life access to the access the top to the access the same and analogous. The access

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Table 29. Parameters for fixed-wing aircraft application of diflubenzuron (wettable powder formulation) in mosquito control.

Formulation	W25 wettable powder
Equipment	Fixed-wing aircraft
Representative nozzle	Teejet 8006, fan spray
Flying speed	120 mph
Boom pressure	20 psi
Atlitude	variable - depending on site
Application rate	0.025-0.04 1bs AI/acre
Volume of application/acre	1 gallon
.Frequency of application	<b>7-10</b> days
Number of applications/season	3
Hours spent flying/day	5
Hours spent in spray swath/day	1
Average length of spray swath	variable
Average acres treated/day	500
Protective clothing (pilot)	Coveralls

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Fixed-wing aircreft

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Table 30. Parameters for fixed-wing aircraft or helicopter application of diflubenzuron (granular formulation) in mosquito control.

Formulation	Granular - 0.25 percent AI
Equipment	Fixed-wing aircraft or helicopter
Application rate	10-16 lbs/acre of granules
Frequency of application	<b>7-</b> 9 days
Number of applications/season	3
Hours spent flying/day	5
Hours spent in spray swath/day	1
Number of workers involved in treatment	2 - applicator and loader
Number of workers involved in formulating	3

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Table 31. Projected extent of use of diflubenzuron in mosquito control, and potential extent of human exposure during the application process.

Number of some to be treated	400 000
Number of acres to be treated	400,000
<ol> <li>Aerial - fixed wing aircraft (granular)</li> </ol>	300,000
2. Ground application (liquid and granular)	100,000
a. Low volume - tractor, jeep, or truck mounted sprayers	50,000
(1) Applied as liquid	25,000
(2) Applied as granular	25,000
<pre>b. Hand-gun, knapsack, or granular applicator</pre>	50,000
(1) As a liquid spray	25,000
(2) As granular	25,000
"Total number of workers involved in hand application	500
Total number of workers involved in low-volume treatments - tractor, jeep or truck	100
Total number of pilots involved in aerial treatment	35
Total number of mixer/loaders involved	100
Number of by-standers present in ground application areas per 5 acres	4
Total number of people exposed in ground application (Application is with hand guns or granular applicators on limited size areas - 1-10 acres)	None
Total number of people present in aerial granular application areas per 100 acres	4
Total number of people exposed in aerial granular application. (The granular formulation is on sand, with oil as a sticker for the diflubenzuron. There is virtually no dust once formulated, the sand particles fall rapidly, and thus no exposure)	None
Time of application for mosquito control	April-October
Percentage of total acreage treated by months :	April 5%; May 5%; June 10%; July 30%; August 30%; September 10%; October 10%.

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		Grown application (liquid and granula:
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	n a.	). Hand-gus, knapsock, or grander
	£5 )	
		no isoligge hash at boxformi easy on to
		of pilots involved in serial treatment
	Ş	of by standers present in ground applite? There is across
		of people errosed in ground are leafing on is with hand gives or granular applicators ted size areas - 1-10 acros)
		er of people a rused in acrial premiar  a. (The granular famulation is on  oil as a stoker for the difficerrarer.  regally no dest onemulated. the some  no exposure.
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refilling the plant hopper 8 times per day. The worst case exposure to the loader would be if the granular were packaged in 50 pound bags, which would require the handling of 24 bags for each loading. Assuming hand loading under these conditions, the loading time would approximate 30 minutes per load. If the granular were handled in bulk and an auger loader was used, the exposure time per load should not exceed 15 minutes.

Assumptions. Certain of the assumptions made to permit calculations of diflubenzuron exposure resulting from its application to water for mosquito control are the same as those previously discussed and used in the cotton and soybean exposure calculations. The assumptions are as follows:

- A. That a large cement mixer is used to mix the diflubenzuron-sand-oil formulation.
- B. That a dust level of 10 mg/m³ will be in the general vicinity of the mixing apparatus during the first 2 minutes of the 65-minute filling and mixing operation, and that a dust cover is placed over the mixer during the entire mixing process.
- C. That once formulated, the granular formulation is no longer "dusty" due to the larvicide oil acting as a dust preventative.
- D. Same as Assumption G, cotton exposure section. Assume 4 hours actual spraying time/day.
- E. Caplan et al. (1956), working with aerially applied malathion in oil sprays, applied 0.46 lb/0.76 gallons (calculated from data)/acre and determined a dermal exposure directly beneath the spray for exposed body areas of 3.556 mg. Assuming a direct relationship between treatment rate/unit area and disregarding differences in spray density and particle size distribution, a correction factor for dermal exposure can be made:

plant Anapper & time, our day, the spirit care managers; the maid be if the granular were portaged in the round hads, which stould a handling of 24 best for each inside . Assuming bond time of ditions, the heading time will open inside as an auger food has "food should not exceed it rimth."

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ssumptions. Certain of the assumptions made in sensor of water for mast sensor the same as those previously discussed.

Seposure calculations. The assumptions are at follow:

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That a dust level of 10 mg/m³ will FE in the peneral incinity of the paretus during the first 2 minutes of the ho-minute filling the sand that a dust mover is placed over the mixer during the

That once formulated, the granular formulation is no arviefde oil acting as a dust preventative.

al. (1956), working with actielly applied maleinion is siles 1b/0.76 g llons (colculated from data)/ocra and determined beneath the spray for exposed body areas of 3.556 mg.

has hot in treatment rate/mit area and distancement at the factor of the factor

$$\frac{0.04}{0.46}$$
 = 0.087

Respiratory exposure under the same conditions is negligible (<1/500th of dermal).

F. Same as assumption I, cotton exposure section, except that the correction factor is calculated as follows:

$$\frac{0.04}{1.0}$$
 = 0.04

- G. Based on data by Wolfe and Durham (1974) relative to backpack sprayer-handgun application of fenthion for mosquito control, it can be calculated that applicators receive a dermal exposure of 0.177 pints spray/applicator/8 hour work day.
  - H. Same as assumption A, cotton exposure section.
  - I. Same as assumption B, cotton exposure section.
- J. Tank filling for aerial application requires 30 minutes/day to mix and transfer 1 batch of 500 gallons. A similar time is required to mix 1 batch of 200 gallons/day for tractor boom sprayers. One mixer is involved/operation.

Unit Exposure Calculations

- A. Mixer/loader (see assumption H, I, J)
  - 1. Aircraft and Tractor-drawn operations
    - a. Dermal exposure  $\frac{1}{2}$ . 52.9 mg/hour of tank fill x 0.5 hour tank fill/day = 26.5 mg/day
    - b. Respiratory Exposure  $10~\text{mg/m}^3~\text{x}~1.8~\text{m}^3/\text{hour (normal breathing rate for light)}$

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mixer/loader (see assumption H. 3. J)

1. Aircraft and line or-drawn operal 1915

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work) x 0.25 (concentration factor) x 0.0028 hours/bag opening
= 0.013 mg diflubenzuron/5 lb bag opening

- B. Pilots (see assumption F)
  - 1. Dermal exposure

1.18 mg/hour x 1 hour/day x 0.04 (correction factor) = 0.05
mg/day

- 2. Respiratory exposure
  - 0.08 mg/hour x 1 hour/day x 0.04 (correction factor) = 0.003
    mg/day
- C. Residents Living in Sprayed Areas Standing Outdoors During Actual Spraying (see assumption E)
  3.556 mg/0.3 m² exposed body area x 0.087 = 0.31 mg/0.3 m²

exposed body area

- D. Formulator (Granules) (see assumptions A, B, C, I)
  - 1. Dermal exposure

 $52.9 \text{ mg/hour } \times 3.25 \text{ hours/days} = 172 \text{ mg/day}$ 

2. Respiratory exposure

10 mg/m 3  x 1.8 m 3 /hour (normal breathing rate for light work) x 0.25 (concentration factor) x 0.033 hours exposure/3,000 lb batch x 4 batches/day = 0.594 mg/day

- E. Backpack sprayer (see assumption G)
  - 1. Dermal exposure

0.022 gallon formulation (0.177 pint)/day x 0.0016 lb AI/gallon x 454,000 mg/lb = 15.98 mg/day

NOTE: Assumes 25 gallons finished spray and 0.04 lb AI diflubenzuron/acre

work) x 0.25 (cook attailed Patter) x 0.0020 hours. Di aponing = 5.013 mg diflibenzuren/5 to big opining

Pilots (see assumption F)

Demed exposure

1.18 mg/hor x I hour/day x 0.04: Prorrection Finte ) 3.

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Residents Living in Seroyed Ass France of states Guriona Spraying (see assumption E)

3.555 mg/0.3 m?.smpnded body area R 0.37 cappaged body area

ra mulator (Granufes) (see assumptions ), 2, . ?)

I. Ograal exposure

52.9 mg/hour a 2.25 hours/44vs = 172 ng/day

2. Respiratory exposure

10 mg/m² x 1.8 m²/hour (normal hreathing rate or light winel x 0.25 (concentration-factor) x 0.033 hour expended. Eff. Latter batches/day = 0.594 mg/day

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## F. Tractor-drawn Boom Applicator

- 1. Dermal exposure

  22.4 mg/hour x 4 hours/day x  $\frac{0.04}{3}$  (application rate factor) =

  1.19 mg/day
- 2. Respiratory exposure 0.12 mg/hour x 4 hours/day x  $\frac{0.04}{3}$  (application rate factor) = 0.0064 mg/day

## GYPSY MOTH

Formulation and Use Patterns. The 25% wettable powder formulation will be used in the application of difflubenzuron to hardwood trees for control of the gypsy moth. It will be applied at a rate of 0.0625 - 0.125 lb AI/acre in a total spray volume (water) of 0.5-2.0 gallons/acre. For mist blower applications, the rate is 1.5-10.0 gallons/acre. Application is to be made only by federal or state personnel involved in pest management programs, or persons under their direct supervision. Application is restricted to a single treatment prior to full leaf expansion when the larvae are in the first, second, and third instars. Application by aircraft will involve the fixed-wing type.

Representative parameters for the use of diflubenzuron in gypsy moth control are shown in Table 32.

Based on actual township demographic studies in Michigan for the areas being sprayed for gypsy moth, the area averaged 1 home/10 acres. Assuming an average of 4 people/home, this would represent 4 people/10 acres. Considering time of treatment (May 15 - June 10), it is not likely that more than one person/home would be outside during spraying.

For the Northeast (PA, NJ, DE, NY), the area might average 2 homes/10 acres. Thus, 8 people/10 acres would be subject to potential exposure.

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2. Respiratory excessing  $\frac{9.98}{3} \text{ [apy lestion rang lest)}$  0.0064 mg/day

ym serion and Gee Patterns, a The 25% workerle powder formerlation mill be in the application of difflubenzurer to hardwood these in control of a control to the seplied at a rate of 0.550 - 0.12'. Alfacricary value (water) of 0.5-2 0 gallons/acre. For mist blover at ons, the rate is 1.5-10.0 gallons/acre. Application is to 31 rate only also state personnel involved in past management a egraps. A personal involved in past management a egraps. A personal involved in the first, second, and third ear expansion when the larvae are in the first, second, and third.

Application by aircraft will involve the first, second, and third.

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Table 32. Parameters for fixed-wing aircraft application of diflubenzuron for control of the gypsy moth.

Formulation	W25 wettable powder
Equipment	Fixed-wing aircraft
Nozzle size ·	8002-8006, Tee-jet
Droplet size	90% over 200 microns
Flying speed	100 mph
Boom pressure	20-40 psi
Flying height	10-30 feet
Rate of application	0.0625 lb AI/acre/season
Volume of application	1 gallon
Carrier	water .
Number of applications	1 per season
Application time	May 1 to June 10
	1 2 1 2 1 2 1

Note: Approximately 50% foliage development which will vary the timing of application because of elevation and geographic location.

Swath width	60 feet
Swath length	1/2 mile
Flying time/day (avg)	3 hours
Swath time/day (avg)	1 hour
Days flying/week	5
Number of hoursin swath/season for 6 week spray period)	30 hours (5 hours/week for 6 weeks)
Frequency of treatment	Possibly one treatment every 3-5 years

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Assuming that 1 person out of 4 per family would be outdoors at the time of spraying, the direct exposure would be 2 people/10 acres treated.

In other areas of the Northeast, the areas to be treated will be totally residential and there will be as many as 300 or more people/10 acres. This is assuming 1/8 acre lots with 4 people/family, or more than 30 people/acre.

Again, assumming 1 person of 4 to be outdoors at the time of treatment, this would be 8 people/acre exposed for a period not to exceed 5 minutes. For the more Western areas of gypsy moth infestation, the concentration of human inhabitants would likely reflect the Midwest condition. The total projected acreage for gypsy moth treatment is about 500,000. This is the estimate of need for control, containment, and eradication programs for 1979, 80, and 81.

Assumptions. The following assumptions were made to permit calculations of human exposure as a result of diflubenzron's use against the gypsy moth:

- A. Same as assumption A, cotton exposure section
- B. Same as assumption B, cotton exposure section
- C. Tank filling operations require 40 minutes/day for one 500 gallon mix/day. At 0.0625 lb AI of diflubenzuron/gallon and 1 gallon finished spray/acre, 500 acres would be treated, requiring 25 bag openings (5 lb. bags).
  - D. Same as assumption E, mosquito exposure section, except that the correction factor is calculated as follows:

$$\frac{0.06}{0.46} = 0.13$$

E. Same as assumption I, cotton exposure section.

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<u>Unit Exposure Calculations</u>. Based on the assumptions and use patterns discussed above, the following unit exposure calculations can be made.

- A. Mixer-Loader
  - Dermal exposure (see assumptions B, C)
     52.9 mg/hour x 4/6 hours/tank filling = 35.5 mg/day
  - 2. Respiratory exposure (see assumption A)
    10 mg/m³ x 1.8 m³/hour (normal breathing rate for light work)
    x 0.0028 hours/bag opening x 0.25 (concentration factor) = 0.013
    mg/bag opening
- B. Pilots (see assumption E)
  - Dermal exposure1.18 mg/hour x 1 hour/day x 0.06 = 0.07 mg/day in spray swath
- C. Residents Living Within Sprayed Area (see assumption D).  $3.556 \text{ mg/}0.3 \text{ m}^2$  of exposed body surface x  $0.13 = 0.46 \text{ mg/}0.3 \text{ m}^2$  of exposed body surface.

## DOUGLAS-FIR TUSSOCK MOTH

Formulation and Use Patterns. The 25% wettable powder formulation will be used in the applications of diflubenzuron to coniferous trees for control of the Douglas-fir tussock moth. It will be applied a maximum of once/year at a rate of 0.125 lb AI/acre. Because of the rugged terrain involved, all treatments will be conducted by helicopter. Table 33 gives representative parameters for diflubenzuron's use against the tussock moth.

- : Expendent Calouday ions. Forest on the assumptions and man per enable of the following unto exposume calculations a ' mad Mixer-Loadur
  - 1. Dermal exposure (see assumbtions o. C)

    52.9 mg/hour x 4/5 hours/tank (filling P o3.5 musery)

Resimilatory exposure (see assumption A)

10 mg/m³ x i.i m³/mound (normal breath) and mark in 199

x 0.0023 hours/bay opening a .25 (curcentration factor U.D)

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Pilots (see assumption E)

in Dermal exposure

1.18 mg/hour v 1 hour/day x 0.06 : 3.07 mg/day is sprey swath
Respiratory exposure

0.08 mg/hour x 1 hour/day x 0.06 = 0.005 mg/day in apray swa esidents firing Mithiu Sprayed Area (see assumetun D).

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stion and use Pettrons. The 25% wellable powder tempolation will be applientions of diffusion zumen to considerous trees for endired of the tussock with, it will be applied a maximum of ence/year at a ratherwise of the magnit terrain involved, all treatments for the constant of the parameters for the constant of the parameters for the constant of the parameters for

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Table 33. Parameters for aerial (helicopter) application of diflubenzuron for control of the Douglas-fir tussock moth.

Formulation	W25 wettable powder	
Particle size of formulation	2-5 microns	
Equipment	Helicopter	
Representative nozzle	Beco-Mist - with #80 head	
Particle size distribution of nozzle	90% greater than 200 microns with less than 10% less than 100 microns	
Flying speed	80 mph	
Boom pressure	30-40 psi	
Altitude	25-50 feet above foliage	
Application rate	0.125 lbs AI/acre	
Volume of application	1 gallon/acre	
Frequency of application	1 treatment/season	
Time of application Early morning - 5-9 a.m.		
Hours spent flying/day	3-4 hours	
Note: Because of weather condition be 3-4 hours out of 10 days 30 day season.	ons, the average flying.time will s and 10 days per pilot out of	
Hours spent in spray swath/day	3	
Average length of spray swath	Highly variable	
Average width of spray swath	125 feet	
Average acres treated/day	20 acres/minute 1,200 acres/hour 3,600 acres/day 36,000 acres/season	
Number of flaggers involved	None	
Average size of nurse tank	1,000 gallons	
Note: Depends on conditions, inc	luding:	

Does he haul his own water to loading site

Number of planes operating

Size of the job Specifications of the contract

100-125 gallons

ameter for serial the leapter) application of diluberz men the Douglas-fir tusseck muth.

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Capacity of nurse tank transfer pump for loading

Time required to fill plane

People involved with loading and mixing

50 gallons/minute

2-2½ minutes

1-2

Will depend on the number of planes operating from nurse truck. If operating from a heli-port, will likely be two.

Type of packaging of active ingredient

Total acres to be treated per season

Predicted occurrence of outbreaks

Total people exposed per 100 acres

Total people exposed per season

Mostly 25 lb. fiber drums with plastic liners

50,000

Once every 9 years

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The forest areas in the Western states where tussock moth outbreaks have occurred are principally non-populated areas. Thus, the assumption is made that a maximum of 1 person/100 acres would be representative of potential bystander exposure. The agreage projected for annual treatment is 50,000. Outbreaks are projected to occur about once every 9 years and the next projected outbreak is 1983. Assuming the above density of population, the maximum number of people exposed would be 500.

Assumptions. The following assumptions were made in the assessment of human exposure to diflubenzuron as a result of its potential use against the Douglas-fir tussock moth:

- A. Same as assumption A, cotton exposure section.
- B. Same as assumption B, cotton exposure section. Since exposure is related to pouring time the 25 lb. drum would result in equivalent exposure to the five 5 lb. bags.
- C. Tank-filling operations require 30 minutes/day to mix and transfer 1 batch of 500 gallons.
- D. Pilot exposure to diflubenzuron sprayed from helicopters will be negligible in comparison to fixed-wing aircraft due to the aerodynamic position relationships of the helicopter rotor, the pilot, and the spray boom. It can be expected that most turbulence coaxial to the helicopter spray path will be at the trailing edge and removed from the pilot.
- E. Same as assumption E, mosquito exposure section, except that the correction factor is calculated as follows:

$$\frac{0.125}{0.46} = 0.27$$

is the Western stairs where the previous or the assumption is made in agrees would be representative of potential bystander in agreege.

To come about once every I years and the next projected butters the fing the above density of population, the most member of page would project the population.

Assumptions. The following assumptions were made in the assessment of expound to diffubenturon as a result of its potential use against the serie tussers moth:

Same my assumption A, cottor exposure settion

Same as assumption 8, rotton exposure section. Since exposure is related to nouring time - the 25 lb. arm. would result in equivalent exposure to the five - 1 lb. bags.

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Filet exposure to diffubenzumen sorayed from helicopters will de negligible in comparison to fixed-wing aircraft due to the acresyments of the helicopter rotor, the pilot, and the apray bear it can be experted that most tenbulence coaxial to the helicopter apray path will be at the trailing educ and removed from the pilot.

... As assumption E, mosquito exposure section, except that the

me farme is calculated as follows:

<u>Unit Exposure Calculations</u>. Based on the assumptions and use patterns discussed above, the following unit exposure calculations can be made.

## A. Mixer/Loader

- 1. Dermal exposure (see assumptions B, C)
  52.9 mg/hour x 0.5 hours/tank filling x 1 tank/day =
  26.5 mg/day
- 2. Respiratory exposure (see assumption A)
  10 mg/m³ x 1.8 m³/hour (normal breathing rate for light work)
  x 0.0028 hours/bag opening x 0.25 (concentration factor) = 0.013
  mg/bag opening
- B. Pilots (see assumption D)
  No significant dermal or respiratory exposure
- C. Residents Living within Sprayed Areas (see assumption E)
  3.556 mg/0.3 m² body surface x 0.27 = 0.96 mg/0.3 m² exposed body surface.

Table 34 gives a summary of the exposure projections discussed above for diflubenzuron's use on cotton, soybeans, forests, and against mosquito larvae.

Threwes Estroletions. Gazed to the exemptions on an as polation, the following unit exensure calculation of the colours of the

1. Dermal exposur: [see ossumpt ons

52.3 mg/howr x U.S howis/lank filling x l kank/may

elory imposure (see assumption 1)

30 mg/m² x l.8 m²/hour (normal breathin rath or ight empt)

x U.5028 hours/bag opening > 0.25 (cancentrician foctor of the my/bag opening)

Pilots (see assumption D)

Mi significant dermal or respections expose sestmotion El Sestdents Living within Sprayed threas (see assumption El S.556 mg/D.2 m² body surrace / 0.27 * 0.2 * 0970 : evnosed body surface.

ble A gives a summary of the export o projections discussor above for nauron's the on cotton, scybeans, forests, and against (maquif larrate.

and bystanders, during the application of diflubenzuron for insect control on cotton, soybeans, and forests, and its direct application to water for mosquito control. personnel Summary of estimated maximum exposure to diflubenzuron of applicators and associated Table 34.

		Maxi	num est	Maximum estimated exposure from indicated application ^a	posure.	from ind	icated	applicat	tiona	
	Cotton	nc	Soy	Soybeans	Fores	Forests-GM ^b	Fores	Forests-TM ^b	Mos	Mosquito
· Person exposed	DC	RC		Z Z	Q	~	0	~		~
Mixer/Loader	1.9	0.013	1.9	0.013	0.16	0.013	0.16	0.013	0.16	0.013
Tractor drawn boom applicator 5.6	5.6	0.033	2.7	0.015	i t	!	1 6	ą ę	0.30	0.0016
Pilot	0.08	0.005	0.07	0.005	0:07	0.005	1	ę (	0.05	0.003
Backpack sprayer	t t	‡	1	;	1	1	;	\$ 1	15.98	\$ 8 .
Formulator ^h ,	1	1	1 2	1	1	ļ i	ŀ	1	1.03	0.594
Bystanderi	0.640	1 1	0.320	1 1	0.46	!	96.0	1	0.31	† †

immediately adjacent to treated areas or, in the case of forest applications, directly beneath the spray. ^aFigures in mg/unit time or event as indicated in appropriate footnotes, ^DGM = gypsy moth; TM = Douglas-fir tussock, moth. ^{CD} = dermal exposure; R = respiratory exposure, ^dmg/day. ^emg/5 lb bag opening. ^fmg/0.3 m² of exposed skin/application. ^gAll spraying done by helicopter, with no significant projected pilot exposure due to aerodynamic properties (see assumption D, mosquito exposure section). ^hFormulator of granules for mosquito applications. ¹Residents or other persons outside in areas bgM = gypsy moth; TM mq/day. emg/5 lb bag

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1									
À									

- Akesson, N. B., W. E. Yates, and R. E. Cowden. 1974. What's happening in Aerial Application Research. Agrichemical Age, December, pp. 9-13.
- Ali, A., and M. S. Mulla. 1977. Chemical control of nuisance midges in the Santa Ana river basin, Southern California. J. Econ. Entomol. 70:191-195.
- Apperson, C. S., C. H. Schaefer, A. E. Colwell, G. H. Werner, N. L. Anderson, E. F. Dupras, Jr., and D. R. Longnecker. 1978. Effects of diflubenzuron on <a href="Chaoborus">Chaoborus</a> astictopus and non target organisms and persistence of diflubenzuron in lentic habitats. J. Econ. Entomol. In press.
- Barness, L. A., and others. 1976. Commentary on breast-feeding and infant formulas, including proposed standards for formulas. Pediatrics 57:278-285.
- Booth, G. M., J. Reed, and C. Monson. 1976. A bio-accumulation study of Dimilin W-25 in rainbow trout and bluegill sunfish. Report to Thompson-Hayward Chemical Co.
- Bull, D. L., and G. W. Ivie. 1978. Fate of diflubenzuron in cotton, soil, and rotational crops. J. Agric. Food Chem. 26:515-520.
- Campt, D. 1977. Letter to Thompson-Hayward Chemical Co., Section 103.1.4.

- en, N B., W. E. . . and R. E. Lener 1974. In it are ng al Application Research. Agrichenical co. ER
- and Just. Willo 197. Chemical of trol . sa has sive basin, Southern Californ a detan.

  - es L. A., and others, 1976. Comment in pres -feedard of foi les, including proposed standards for formula Pedistrics 57:278-295.
  - 1. M., J. Rest, and E. Monson. 1976. A bio-accumulation stars of the star of t
- L., and G. W. Ivie. 1975. Fate or diffusencement in corran, soil, and ation... d. Apric. Fued Chem. 26 515-520.

Hompsen-Huggard Chemical Co., Seeling 183.3.3.

- Caplan, P. E., D. Culver, and W. Thielen. 1956. Human exposure of populated areas during airplane application of malathion. AMA Arch. Ind. Health. 14:326-332.
- Carringer, R. D., J. B. Weber, and T. J. Monaco. 1975. Adsorption desorption of selected pesticides by organic matter and montmorrillonite. J. Agric. Food Chem. 23:568-572.
- Clark, D. E., G. W. Ivie, H. R. Crookshank, J. A. DeVaney, and D. L. Bull.

  1978. Effects of sulprofos and its sulfoxide and sulfone metabolites on
  laying hers fed the compounds in the diet. J. Agric. Food Chem. In press.
- Collins, J. R. 1978. Residues in run-off water from cotton plots. Report to Thompson-Hayward Chemical Co. (Residue report #1653).
- Colwell, A., and C. Schaefer. 1978. Effects of Dimilin on non target organisms during a Chaoborus field trial. Environ. Entomol. In press.
- Donigan, A. S., D. C. Beyerlein, H. H. Davis, and N. H. Crawford. 1977.

  Agricultural Runoff Management (ARM) Model, Version II: Refinement and

  Testing. USEPA, Athens, GA.
- Falco, J. M., L. A. Mulkey, K. F. Hedden, C. N. Smith, T. O. Barnwell, J. D. Dean, R. E. Lipcesei, and M. C. Smith. 1978. Estimated degradation and transport of Dimilin in selected rivers of the Southern United States. USEPA, Athens, GA. (August, 1978).

ver, and W. Thielen. 1935. Marks compare of permist.

J. R. Weker, and T. J. Monacq 1375., dom - " mws
selerted pesticides by eroanicimatter and monthsour
them 29-568-571

7. E., G. W. Iv a, B. R. Crucksh hi, ... ** ** ** ** ** ** ** ** **
Effects sultroles and its sulforable and alfone med
{ ind news fed the compounds in the diet. J. Acric For her a ar

p. 1378 Residues in run-off water from editin i naa boops on-Hayward Chemical Co. (Residue repurt 816

A., and C. Schwefer, 1979. Eifects of Divilla, no tel orget during a Chaoberts field trial. Environ. Entouch. to press.

A. S., D. C. Beyerlein, H. H. Davis, and M. H. Crasferd. 1973 ricultured Tunoff Management (ART) Model, Version 17; di imment esting USEPA, Athens, GA.

were sever. R. F. Medden, C. M. Smith. F. D. Barmall J. D.
W. C. Smith. 1970 Factomated despisabling on

- Farlow, J. E., T. P. Breaud, C. D. Steelman, and P. E. Schilling. 1978.

  Effects of the insect growth regulator diflubenzuron on non target aquatic populations in a Louisiana intermediate marsh. Environ. Entomol. 7:199-204.
- Gemma, A. A. 1975. TH-6040 Residues in run-off water. Report to Thompson-Hayward Chemical Co. (Residue report #1016).
- Gusey, W. F., and ?. Maturgal. 1973. Wildlife utilization of crop lands.

  Shell Oil Co., Houston, TX., Technical Bulletin.
- Harris, L. E. 1975. Guide for Estimating Toxic Residues in Animal Feeds or Diets, Report to USEPA #EPA-540/9-75019.
- Ivie, G. W. 1978a. Fate of diflubenzuron in cattle and sheep. J. Agric. Food
  Chem. 26:81-89.
- . Ivie, G. W. 1978b. Unpublished data.
  - Jegier, Z. 1964. Exposure to Guthion During Spraying and Formulating. Arch. Environ. Health 8:565-569.
  - Jegier, Z. 1964a. Health hazards in insecticide spraying of crops. Arch. Environ. Health 8:670.
  - Julin, A.M., and H. O. Sanders. 1978. Toxicity of the IGR diflubenzuron to fresh water invertebrates and fishes. Mosq. News 33:256-259.

- placed the insect growth regulation disjulieraumen on and man under one in a Louisiana intermediate marsh. Entire. In 100-204.
  - A. 1975. TH-6040 Rosidues monery water. Report
  - F., and P. Hatergel. 1973. Wildlife Lilikation " 13.
    #11 011 Co., Hourier IV Technical Bulling.
- - u. 1878a. Face of diflubenzurm to Cattl 3 P. 7. 26:83-29.
    - M. 1978b. Ungulilished Gita.
  - Z. 1964. Exposure to Rechien During Spraying . "Il or seeks to seek to be seeks to be seek
- L. 196-3. Acalth hezards to besettiches sorgying of cours. Arch.

s senders. 1973, Truic is of the lift doft warman in

ed fishes, Mesd. Mews 30; New 9.

e continue de la cont

- Kenaga, E. E. 1973. Factors to be considered in the evaluation of the toxicity of pesticides to birds in their environment. <u>In</u>: Environmental Quality and Safety. Global Aspects of Chemistry, Toxicology and Technology as Applied to the Environment, Vol. II. Academic Press, N.Y., N.Y., pp. 66-181.
- Lehman, A. J. 1962. Quarterly Bulletin of the Association of Food and Drug Officials, Vol. 26, No. 3 (July, 1962).
- Lehman, A. J. 1965. Summaries of Pesticide Toxicities. Assoc. Food and Drug Officials of the U.S.
- McAlonan, W. G., F. J. Murphey, and R. W. Lake. 1976. Effects of two insect growth regulators on some selected salt marsh non target organisms. N.J. Mosq. Ext. Assoc. 63:198.
- Miller, R. W., C. Corley, and K. R. Hill. 1975. Feeding TH-6040 to chickens; Effects on larval houseflies in manure and determination of residues in eggs. J. Econ. Entomol. 68:181-182.
- Miller, R. W., C. Corley, D. D. Oehler, and L. G. Pickens. 1976. Feeding
  TH-6840 to cattle; Residues in tissue and milk and breakdown in manure. J.
  Agric. Food Chem. 24:687-688.
- Miura, T., and R. M. Takahashi. 1974. Toxicity of TH-6040 to fresh-water crustacea and the use of a tolerance index as a method of expressing side

- percialles to birds in their environment. In: Covincemental health

  Safety. Clobal Aspects of Chemistry, Taxicalous and Tanna

  Upplied to the Environment, Vol. 11. Academic Pres. 11 (1. 18.7), pp.

  - J 1965, Summaries of Peckickas Torixities. Assoc Found cuals of the L
- M. G., F. J. Mr phey, and R. M. Loka, 79.5. a rera se us insected regulators or some relected sels marsh non-targe? or some telected sels marsh non-targe? or some fixt. Assoc. 65,198.
- W., C. Corley, and K. R. Mill. 1975. Recling TH-8091 to chickens:

  on larvel houseflies in menure and determination of reviews in

  s. J. Econ. Entermi 68:121-182.
- R. M., C. Corley, D. D. Dehler, and L. G. Pickuns. 1976 Feeding
  ) to cattle; Residues to Sissue and milk and breakflown in reducts. J.
  Food Chem. 20:567.533.

shaped - 1974. Forfelly of TH-5040 to Prychewalter you cannot be character to the property and

effects on non targets. Calif. Mosq. Contr. Assn. Proc. 42:177-180.

- Miura, T., W. D. Murray, and R. M. Takahashi. 1975. Effects of Dimilin on non target organisms in early spring <u>Culex tarsalis</u> larval habitats. Calif. Mosq. Contr. Assn. Proc. 43:79-83.
- Miura, T., and R. M. Takahashi. 1975. Effects of the IGR TH-6040 on non target organisms when utilized as a mosquito control agent. Mosq. News 35:154-159.
- Mulla, M., G. Majoria, and H. A. Darwazeh. 1975. Effects of the insect growth regulator Dimilin or TH-6040 on mosquitoes and some non target organisms.

  Mosq. News 35:211-216.
- Nimmo, W. B., and P. C. deWilde. 1974. Fate of PH 60-40 applied on the leaves of corn, soybean, cabbage, and apple. Report to Thompson-Hayward Chemical Co.
- Nimmo, W. B., and P. C. deWilde. 1975. Degradation of diflubenzuron in soil and natural water. Report to Thompson-Hayward Chemical Co.
- Nye, D. 1977. Thompson-Hayward Chemical Co., Kansas City, KS. Private communication to D. L. Bull and G. W. Ivie.
- Petrocelli, R. 1975. Unpublished data. Bionomics EG&G, Inc., Marine Res. Lab., Pensacola, Fla.

- T., W. O. Murray, and n. . inhabathle 378. Efford or untils marge to organisms in.

  And the organisms in. y spring Gelog targe is larged habited organisms. Precedence 42:79-83.
  - T., and R. M. Sakahashi. 1975 Effects of the 16% TP-wisks as Organi m. when thread or mosquit control equ
  - Pagelator Dimillo or TM-6040 : meshared and server or target Mosq. News 35:211-216
    - norm; soybran, cebt ve, and apple. Report to Thompson Mayes
    - B., and P. C. deWilly 1035. Tagmard. Lies of diff A. ... on unal water. Report to Thempson-Layuard Enemisalin.
  - . Theograph-Haymard Dhomical Co., Kansas City, 15. Private runices on to O. E. Wull and G. W. Ivie.

- Rosene, W. 1969. The bobwhite quail: Its life and management. Rutgers Univ. Press, New Brunswick, N.J.
- Schaefer, C.H., and E. F. Dupras. 1976. Factors affecting the stability of Dimilin in water and the persistence of Dimilin in field waters. J. Agric. Food Chem. 24:733-739 (1976).
- Schaefer, C. H., and E. F. Dupras. 1977. Residues of Diflubenzuron

  [1-(4-chlorophenyl)-3-(2,6-difluorobenzoyl) urea] in pasture soil,

  vegetation, and water following aerial applications. J. Agric. Food Chem.

  25:1026-1030.
- Schaefer, C. H., E. F. Dupras, Jr., R. J. Stewart, L. W. Davidson, and A. E. Colwell. 1978. The accumulation and elimination of diflubenzuron in fish. Bull. Environ. Contam. Toxicol. In press.
- Severn, D. J., H. L. Boyd, and P. R. Datta. 1978. Exposure analysis for Endrin. Chemistry Branch, C&E Division, OPP, EPA, June 19, 1978.
- Shea, P.J. 1977. Unpublished report to the Douglas-fir tussock moth research and development program. 72 pp.
- Smith, K. S. 1976. TH-6040 residues and metabolism study in poultry. Report to Thompson-Hayward Chemical Co.
- Smith, K. S., and D. L. Merricks. 1976. TH-6040 tissue residue and metabolism study in dairy cows. Report to Thompson-Hayward Chemical Co.

- fe . C.H., and C. F. Bupras, 1576. Frefats affecting the seability of Dimilion to water _ the poreference of Dimilion in Field various for d Chom. 24:725-717 (1876).
  - [1-{A chloropheny!}-3-{2 5-diffuorobenzuy ' uroal in "Yegototion, and water following zerial applications 3 nersa, shows 1836-1839.
    - es or Fill. E. : Orgrest, J., R. J. Stewars, t. W. D. 1930...

      Colwell. 1978. The ess. whation and elimination or
      Buil. Environ. Content Turscol. In press.
  - ing D. J., H. L. Boyd, and P. R. Cotta. 1978, Exposure analysis for fin. Checkstry Pranch, C&C Division, OPP
    - P.J. 1977. Unpublished report to the Roughas-fit Yesseld much development progress, 72 pp.

is 1976. Predict bissess are successful and are are in

- Steelman, C. D., J. E. Farlow, T. P. Breaud, and P. E. Schilling. 1975.

  Effects of growth regulators on <u>Psorophora columbiae</u> (Dyar and Knab) and non target aquatic insect species in rice fields. Mosq. News 35:67-76.
- Stewart, B. A., D. A. Woolhiser, W. H. Wischmeier, J. H. Caro, and M. H. Frere.

  1976. Control of water pollution from cropland. Vol 2--an overview.

  USDA, ARS, OUSEPA, Off. Res. Dev. 187 pp.
- Stoddard, H. L. 1936. The bobwhite quail, its habits, preservation, and increases. Charles Scribner's & Sons, N.Y., N.Y. 559 pp.
- Tripanzee, R. E. 1948. Wildlife management. McGraw-Hill, N.Y., N.Y., 2 Volumes.
- Tucker, R. K. 1975. Criteria Upon Which to Trigger Exercise of Conditional and Special Tests for Avian Wildlife, Ecological Effects Branch, Criteria and Evaluation Division, Office of Pesticide Programs, USEPA, 4 pp.
- Verloop, A., and C. D. Ferrell. 1977. Benzoylphenyl ureas--A new group of larvicides interfering within chitin deposition. ACS Symp. Ser. 37:237-270.
- Wolfe, H. R., W. F. Durham, and G. S. Batchelor. 1961. Health hazards of some dinitro compounds: Effects Associated with Agricultural Usage in Washington State. Arch. Environ. Health. 3:468.
- Wolfe, H., J. F. Armstrong, and W. F. Durham. 1974. Exposure of mosquito

- c. D., J. Forlaw, T. P. Breaud, and P. E. Schilling. 1975.

  Is of growth regulators on Psoconbora columbias (Byos and Root) and to get aquabic insect species in rice Halds. Hosq. Nov. 35 67
- A., D. & Moolhiser, W. H. Mischmeior, J. R. Caro, and R. H. Front 1976. Central of water pollution from cropland. Vol 2--an even ich fine-gusepa, Off. Res. Dev. 187 pp.
  - no. H. L. 1936. The Bobwi to quail, its hebits, preservation, and asset. Charles Scribner's & Sons, M.Y., N.Y., 559 pp.
  - R. E. 1948. Mildirfa management. McGrow-Hill, M.Y., R.Y., 2 Vo umes.
  - n R. K. 1975. Orizeria Upon thanh to Prigger Exercise of Conditi Smecial Tests for Avian Hildlife, Ecological Effects Branch, Criteria as Evoluation Division, Office of Pesticide Programs, USEPA, A ro.
    - o, A., and C. D. Ferrell. 1977. Renzoylabery) urease-A and grad of a vicides interfering within chitun deposition. ACS Symp Services 1:231-278.
- F. Day and G. S. Batcheler. 1961. Health barards of shad anode: Fit sets Associated with Apricultural Usage in

control workers to fenthion. Mosq. News 34:263-267.

Yates, W. E., N. B. Akesson, and H. Coutts. 1967. Trans ASAE 10:628-638.

Yates, W. E., N. B. Akesson, and R. E. Cowden. 1974. Criteria for minimizing drift residues on crops downwind from aerial applications. Trans. ASAE 17:627-632.

control workers to Panthian. Masq. mays 34.263-207.

Yates, M. E. W. B. Akesson, and H. Dadtes. 1969. Franciski ID-685-415.

defect N. E., N. B. Akesson, and R. E. Comben. 1970. Criceria for minimizing

- 250-12051L



